Siting Livestock and Poultry Operations for the 21st Century

Symposium Proceedings

Ottawa, Ontario
July 13 - 14, 1995

Edited by Dr. J.A. Munroe
The need for this Symposium focussing on environmental and socio-economic issues related to the siting of large livestock and poultry operations was identified as a priority item by the Expert Committee on Agricultural Structures, and supported by the Canada Committee on Animals, and the Canada Committee on Natural Resources, as well as the Canadian Agri-Food Research Council. As a result, a two-day event was organized for July 13-14 to immediately follow the Agricultural Institute of Canada and Canadian Society of Agricultural Engineering conferences in Ottawa. The specific purposes of the Symposium were to:

- assess the current Canadian situation
- identify research and technology transfer needs
- identify other related recommendations.

These Proceedings contain general recommendations emanating from the symposium, recommendations forwarded to CARC, presentations of all invited speakers, results of discussion groups, and presentations of all members of the synthesis panel for the Symposium. Texts of the speakers are in the language of choice of the speaker. As well, a list of all attendees including addresses is appended.

Symposium Proceedings are being forwarded to appropriate commodity groups as well as to federal, provincial and municipal agencies.

ACKNOWLEDGEMENTS
The Steering Committee wishes to thank all speakers, group session leaders and scribes, and others who contributed to the success of the Symposium. We particularly acknowledge the financial contributions of CARC; Ontario Ministry of Agriculture, Food and Rural Affairs; Environment Bureau, AAFC; Canadian Pork Council; and the Canadian Society of Agricultural Engineering. The administrative support provided by the Centre for Food and Animal Research, and in particular that of T. Armstrong in organizing local arrangements, and M. Goodfellow in preparing the final manuscript of these Proceedings are very much appreciated.

STEERING COMMITTEE
Dr. Jim Munroe, Chair
Agriculture and Agri-Food Canada

Mr. Don Allen
Nova Scotia Agric. College

Mr. Yves Choinibre
Ont. Min. of Agric., Food and Rural Affairs

Mr. Jim Dalrymple
Ont. Min. of Agric., Food and Rural Affairs

Dr. John Feddes
Univ. of Alberta

Dr. Bev Kay
Univ. of Guelph

Dr. Louis Laflamme
Agriculture and Agri-Food Canada

Mr. Michael Toombs
Ont. Min. of Agric., Food and Rural Affairs

For further information regarding the Symposium, contact Dr. Jim Munroe, Centre for Food and Animal Research, Bldg. 94, Agriculture and Agri-Food Canada, Ottawa, ON, K1 A OC6, by telephone (613) 759-1585, by facsimile (613) 759-1596, or by e-mail to munroej@em.agr.ca.

Experts from Canada and abroad in the area of environment and production in agriculture gathered in Ottawa on July 13-14, 1995 for a symposium on Siting Livestock and Poultry Facilities. The initiative for this symposium, which crosses many disciplines, was taken by the CARC Expert Committee on Agricultural Structures/Canada Committee on Animals. Major symposium sponsors included Canadian Agri-Food Research Council (CARC), Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), and Environment Bureau, Agriculture and Agri-Food Canada.

This two-day event brought together approximately 100 representatives from industry, federal and provincial governments, universities, livestock commodities and the environmental sector.

The objectives were to assess the current issues related to location of animal agriculture operations and its impact on the environment, and to identify future opportunities in the research and technology areas to maintain animal agriculture’s key role in the Canadian economy.

Topics included:
- European/American/Canadian Viewpoints
- 3 Provincial Viewpoints - B.C /Ontario/Quebec
- Industry - Dairy/Beef/Swine/Poultry
- Land Use Planning Perspective
- Legal Aspects/Implications
- Federal Policy Perspective
- Emerging Technologies:
  - Biotechnology
  - Engineering
  - Nutrient Management

It is clear that present day nuisance and pollution problems caused by production agriculture are minimal when compared to other industries in Canada and even to agriculture in the more densely populated parts of the world. Conflicts do exist however in some municipalities and can only heighten as the rural, non-farm populations continues to grow. Some technologies and procedures reviewed at the symposium included a better balance of animal production and land base within regions and amino acid level adjustments in the diets to reduce nitrogen and ammonia release. Other methods of odour reduction such as feed additives, field injection and storage covers were reported.

It was generally agreed that management systems that increase environmental sustainability should be required of all producers. This recommendation is coupled with a move to protect the farmer from lawsuit if an approved practice is being followed.

A better understanding of farm practices by rural neighbours is an essential element in reducing conflict. Legislation in parts of Europe call for restrictive and expensive procedures in the way livestock and their products are handled. Solutions must be economically sustainable to have any hope for acceptance. It was noted that Canadian pork producers through the Canadian Pork Council have initiated an Environmental Action Plan aimed at reducing negative impacts to to surroundings.

This is the first symposium of its kind in Canada which brought such a broad representation of stakeholders together to discuss this important issue. The attendees were encouraged that with understanding, good management and cooperation, livestock producers and their neighbours will
The following recommendations are a result of the two-day national symposium on environmental and socio-economic issues related to the siting of livestock and poultry operations. These recommendations should be considered if challenges facing siting of animal facilities are to be overcome.

**GENERAL RECOMMENDATIONS**

**Education**
- Animal agriculture must increase communication of its value to society and the Canadian economy.
- Increased education needs to occur in both the producer and public sectors particularly with regard to how livestock is raised, and how to improve the interface between livestock operations and neighbours.

**Management**
- Nutrient management planning, possibly on a municipal or a larger scale as opposed to single farm operation, should be encouraged.
- It may not be the size of the farm and the number of animals but the knowledge and management capabilities of the farm owner/operator that are necessary for efficient environmentally sound production units.

**Regulation**
- Standardization/harmonization of siting regulations and guidelines need to occur between municipalities, provincial and federal levels of government.
- Peer reviews of environmental issues related to animal agriculture may be more effective than government intervention.
- National Environmental Codes of Practice should be encouraged in all commodity sectors.

**RECOMMENDATIONS TO CARC**

Research and technology transfer needs and opportunities to overcome the environmental, social and economic challenges of siting livestock and poultry facilities are as follows:

A. Biotechnology (opportunities to reduce the levels of nitrogen, phosphorous and moisture in livestock wastes); more effort is required to seek further developments in the following areas:
   1. Ration Formulation
   2. Nutrient Availability
   3. Enzymes
   4. Amino Acid
   5. Genetics

B. Engineering; further work is required in the following areas to improve the siting of livestock operations as well as reduce the potential for degradation of the environment
   1. Solid/Liquid manure separation and utilization of different fractions.
   2. Reduced water use
   3. Composting

C. Nutrient Management; the following will assist in making livestock operations more economical as well as socially acceptable
   1. A more scientific approach to planning and application of manure to land
   2. Manure nutrient analysis - quick on-farm testing

D. Systems Approach; consider animal wastes on a continuing, revolving basis
   1. Reduce manure nutrient losses
   2. Re-use/Recycle components of manure within a external to farm operation..
Des experts internationaux en environnement et en production agricole se sont réunis à Ottawa, les 13 et 14 juillet derniers, pour participer à un colloque portant sur l'implantation des élevages de bétail et de volaille. Cette réunion multidisciplinaire, parrainée principalement par le Conseil de recherches agro-alimentaires du Canada (CRAC) et par le ministère de l'Agriculture, de l'alimentation et des affaires rurales de l'Ontario (OMAFRA), était organisée à l'initiative du Comité d'experts des constructions agricoles et du Comité canadien des productions animales du CRAC.

Les technologies qui ont été discutées durant le colloque portaient sur un meilleur équilibre entre la production animale et l'utilisation des sols dans une région, et l'ajustement des niveaux d'acides aminés dans les rations pour réduire l'ammoniaque et l'azote. Les méthodes considérées pour réduire les odeurs étaient l'addition d'additives chimiques, l'injection du fumier directement dans le sol, et l'utilisation de couvertures sur les structures d'entreposage.

En général, les systèmes de gestion qui sont plus écologiquement acceptables devront être pratiqués par tous les producteurs. Cette recommandation a pour but de protéger les producteurs contre les actions juridiques.

Une meilleure compréhension des opérations agricoles est essentielle pour réduire les conflits. En Europe, la législation demande des procédures restrictives et coûteuses pour éviter les problèmes; préférablement, les solutions doivent être plus acceptables. On a noté que les producteurs de porcs canadiens ont commencé à développer un code qui a pour but, la réduction des impacts négatifs des pratiques agricoles sur l'environnement.

Ce colloque est le premier du genre au Canada. Il a attiré plusieurs experts en environnement et en production agricole. Tous les participants croient fermement qu'avec de la collaboration et une bonne gestion, les producteurs agricoles et les communautés adjacentes pourront partager une
LES EMPLACEMENTS DES BÂTIMENTS D’ÉLEVAGE DE BÉTAIL ET DE VOLAILLE POUR LE 21e SIÈCLE

Les recommandations suivantes viennent d'un colloque national portant sur des facteurs environnementaux et socio-économiques concernant les emplacements des bâtiments d'élevage de bétail et de volaille. Ces recommandations devront être respectées pour réduire les risques de conflits entre les producteurs et les communautés avoisinantes, et aussi pour pratiquer une agriculture qui est plus écologiquement acceptable.

RECOMMANDATIONS GÉNÉRALES

Education

Le secteur de l'élevage doit faire une meilleure promotion de sa valeur pour la société et pour l'économie du Canada.

Il convient de mieux éduquer les producteurs et les responsables des secteurs publics. Le problème est-il imaginaire ou concret?

Gestion

La gestion des nutriments devrait se faire sur une échelle municipale ou régionale.

La capacité de gérer une exploitation dans le respect de l'environnement risque de dépendre moins de la taille de l'exploitation et du nombre d'animaux produits que des connaissances et des aptitudes du propriétaire ou de l'opérateur en matière de gestion.

Réglementation

Les administrations municipales et les gouvernements fédéral et provinciaux doivent normaliser et harmoniser leurs règlements et leurs lignes directrices.

L'examen par les pairs des problèmes environnementaux liés à l'élevage risque d'être plus efficace qu'une intervention gouvernementale.

On devrait encourager l'adoption de codes nationaux de bonnes pratiques environnementales (comme celui des producteurs de porc).

RECOMMANDATIONS CONCERNANT LA RECHERCHE ET LE TRANSFERT DE LA TECHNOLOGIE

Voici quels sont les besoins et les possibilités de la recherche et du transfert de la technologie dans ce domaine

A. Biotechnologie (possibilités de réduire la teneur en azote, en phosphore et en humidité des déchets d'élevage) plus d'effort est requis dans les suivants:

1. Préparation des rations
2. Disponibilité des nutriments
3. Enzymes
4. Acides aminés
5. Génétique

B. Génie; plus d'effort est requis, face-à-face les suivants, pour améliorer les situations existants et minimiser les problèmes environnementaux:

1. Séparation et utilisation des fractions solides et liquides du fumier
2. Réduction de l'utilisation et de la consommation d’eau
3. Compostage

C. Gestion des nutriments; les recommandations suivantes devraient permettre aux opérations d'élevage d'être plus économiques et écologiquement acceptables.

1. Approche plus scientifique de la planification et de l'épandage du fumier sur les terres
2. Dosage des éléments nutritifs du fumier - méthodes rapides utilisées sur place

D. Approche systémique;
CONTENTS

PREFACE ......................................................................................................................................... I
EXECUTIVE SUMMARY .................................................................................................................. ii
SOMMAIRE EXECUTIF .................................................................................................................... iv

Opening Remarks
Jim Dalrymple ....................................................................................................................... 1
American Experience
Dr. Andy Manale .......................................................................................................... 2
European Experience
Dr. Hein Korevaar .......................................................................................................... 14
Canadian Perspective
Bob Robson ....................................................................................................................... 26
Current Canadian Situation
British Columbia - Dave Sands ................................................................................... 28
Ontario - Mike Toombs .............................................................................................. 39
Quebec - Michel Patoine ............................................................................................... 45
Producers’ Perspectives
Dairy - Charlie Iberg ........................................................................................................... 63
Beef - Larry Helland ........................................................................................................... 65
Swine - Gerry Friesen .......................................................................................................... 69
- Joe Van Vulpen ....................................................................................................... 72
Poultry - Craig Hunter ........................................................................................................... 74
Other Perspectives
Land Use Planning - Dr. Wayne Caldwell ..................................................................... 76
Legal Implications - Dr. Serge Rousselle ..................................................................... 90
Federal Policy - Christine Nymark ................................................................................. 97
Emerging Technologies
Biotechnologies - Dr. Al Fredeen ................................................................................. 101
Engineering - Dr. Jerry Leonard .................................................................................. 112
Nutrient Management - Dr. Rob Janzen ........................................................................... 125
Reports of Breakout Sessions ............................................................................................. 140
Synthesis Panel Remarks
Dr. Gord Surgeoner -Chair ............................................................................................. 152
Dr. Andy Manale ................................................................................................................. 156
Dr. Hein Korevaar .............................................................................................................. 158
Sally Rutherford .................................................................................................................. 160
Dave Hanly ......................................................................................................................... 161
Dr. Ernie Barber .................................................................................................................. 164
Closing Remarks
Jim Dalrymple ..................................................................................................................... 166
List of Attendees .................................................................................................................... 167
I would like to take this opportunity to welcome everyone to this symposium dealing with siting livestock and poultry units for the 21st century.

The Canadian Expert Committee on Farm Structures, the Canada Committee on Animals, and the Canadian Agri-Food Research Council have dealt with issues which have come to the forefront in recent years including the areas of biotechnology, animal welfare, and animal agriculture and its relationship to the environment.

In 1994, the Canadian Expert Committee on Farm Animal Welfare and Behaviour held a seminar at Guelph titled, "Farm Animal Welfare Canada-Past, Present and Future". This workshop was intended to take a look at farm animal welfare and behaviour and future research and technology needs.

The Canadian Agri-Food Research Council is pleased to be taking part in this 1995 seminar on animal agriculture and the environment. Over the past several years, a number of provinces and livestock commodities have brought the issues of animal agriculture and the environment to national meetings and to the Canadian Agri-Food Research Council.

The Canadian Agri-Food Research Council's role is to "build consensus on research priorities and technology transfer" needs. In this regard, research and technology transfer is directed to assist the agriculture and food industry to be globally competitive, environmentally sustainable, and socially responsible. We feel that this 1995 symposium in Ottawa will help us ensure that animal agriculture continues to play a key role in the Canadian economy.

The Canadian Agri-Food Research Council, under its Canada Committee on Animals, has five Expert Committees, namely, Farm Structures, Welfare and Behaviour, Nutrition, Breeding and Reproduction, and Heath. These Committees are made up of government and industry representatives who assess research and technology transfer needs in each of these important areas.

The Symposium Steering Committee appreciates the generous financial support for this symposium from the Canadian Agri-Food Research Council, the Ontario Ministry of Agriculture, Food and Rural Affairs, the Environmental Bureau of Agriculture and Agri-Food Canada, the Canadian Society of Agricultural Engineering, and the Canadian Pork Council.

Environmental and socio-economic issues related to the siting of large livestock and poultry operations are global issues. We are pleased to have speakers from both the United States and the Netherlands here to address these issues, as well as Mr. Bob Robson to give us a Canadian Perspective.
LIVESTOCK INDUSTRY STRUCTURE AND ENVIRONMENTAL QUALITY IN THE UNITED STATES

Dr. Andy Manale
Environmental Protection Agency Washington, USA

A Senior Program Analyst in the Office of Policy, Planning and Evaluation of the US Environmental Protection Agency
Manages Comprehensive Economic and Environmental Policy Evaluation System (CEEPES), an analytical system for geographic planning
Under a German Marshall Fund Environmental Fellowship, examined the effectiveness of the European Community's

ABSTRACT
The current structures of the dairy, poultry, swine, and cattle feedlot industries in the United States lead both to problems of environmental quality, as well as opportunities to correct these problems. Contracting between small producers and large food processors and vertical integrators increasingly characterizes livestock production. Decisions by the processors and integrators regarding the volume of their production directly affect its intensity and hence the volume of animal manure that must be eliminated. Intense competition among producers for these contracts reduces the ability to pass on the cost of environmental protections to downstream buyers. Since the producers do not sell directly to consumers, they are not able to capture the "green" premium that consumers may be willing to pay. Nevertheless, economies of scale present at the level of the processor and/or integrator can efficiently resolve the dilemma. These opportunities are identified and discussed. Possible policies to encourage responsible waste management are suggested.

ENVIRONMENTAL QUALITY AND THE LIVESTOCK INDUSTRY
The livestock industry contributes to problems in environmental quality in a variety of ways. Animal operations, particularly those relating to dairy, poultry, and swine operations, account for one-third of all agricultural non-point (diffuse) source pollution (USEPA, Office of Water, 1994). Nutrient runoff and leaching from animal waste has impaired fisheries in 60,000 stream miles, caused extensive fish-kills in California and Florida, and contaminated ground water in 17 states. The livestock industry is the second largest source of anthropogenic methane, which adds to potential global warming, and contributes about one-third of U. S. anthropogenic methane emissions (USEPA, Office Air and Radiation, 1994). And fugitive dust from rangeland and cattle feedlots contributes significantly to violations of U.S. air quality standards, particularly for particulate matter (USEPA, Office of Air and Radiation).
Manure has historically been considered a valuable fertilizer for crop production. However, with the development of low-cost chemical fertilizers in this century, its use in crop production has declined. When applied at agronomic rates to growing crops, nutrients derived from manure rarely pollute ground or surface waters. However, the concentration of large numbers of animals relative to the availability of cropland has led to the overproduction of nutrients in relation to the economic feasibility of their use as fertilizer. Excess phosphorous or nitrogen from animal "waste" or dead animals that is not taken up by crops or grasses can move to ground or surface waters. Large amounts of animal waste over large areas cause ammonia emissions that can lead to acid rain. Surface application of animal waste, particularly poultry and swine waste, in areas in relative close proximity to populated areas cause problems of odor. Over application of manures over extended periods of time can cause the build-up of phosphorous in the soil to levels that seriously affect the productivity of the land.

The preponderance of poultry and an increasing share of dairy and pork products are produced under contract to food processors and vertical integrators, large companies that link together various portions of the production, input-supply, and market segments of an industry (Heffernan, 1992 and Center for Agricultural and Rural Development, 1994). Secondary products, such as manure or dead animals, which have no value to the wholesale buyer (with the exception of feathers, blood, and bonemeal to the integrator as a valuable source of high protein feed additive) and limited value to the specialized producer, become waste to be disposed of as cheaply as possible. Contracts, for the most part, do not explicitly state who owns the animal waste or define the responsibility for environmentally sound management. [This is, however, changing slowly as more companies become aware of the potentially negative publicity and community resistance to their industries with the mismanagement of nutrients from animal production.] For industries that are highly integrated, greater responsibility of the integrator for disposal of animal waste reduces government enforcement cost of ensuring compliance of regulations at the level of the producer.

It is unclear how the assumption of greater environmental responsibility by the integrator or food processor affects the concentration of the industry or the competitiveness of the small producer. However, initial studies of the dairy industry suggest that the moderately sized dairies are likely to be affected more adversely if they are required to meet strict environmental regulations than large-scale dairies [(Outlaw et al, 1993).

THE PROBLEM OF MARKET FAILURE AND ANIMAL WASTE

The environmental problems associated with the mismanagement of animal waste from livestock operations is the consequence of what economists call "market failure." Imperfect information may contribute to market failure. In such situations, the market fails to assign a value to environmentally sound management of animal manure or dead animals and thereby creates a negative externality. Where a value is assigned to the nutrient, its subsequent use (as a fertilizer or feed additive, for example) results in a positive externality.

An externality is a cost that is borne by a person other than the one who caused the cost to arise (Portney, 1990). Externalities arise when an individual, in the course of rendering some service for which payment is received, coincidentally renders services or disservices to other persons for which payment cannot be extracted. In the case of the livestock industry, excessive release of nutrients into the environment affects the welfare of people external to the contractual relationship.
Because the downstream cost of environmental pollution is not borne by the producer, the price of the product does not necessarily reflect what society must sacrifice to enjoy its benefits.

There are three major externalities in the production of livestock that are unlikely to be borne by the producer. The first externality relates to waste. When spread at agronomic rates on cropland reflecting the physical characteristics of the soil, they represent a positive externality and a valuable source of nitrogen, phosphorous and organic material. Application beyond what is taken up by plants creates a negative externality when excess nitrogen and/or phosphorous leaches into the groundwater or contaminates surface water. A second externality arises when the by-products from processing discharged directly into surface waters. In the United States, most vertically-integrated companies in the poultry industry have developed rendering plants to alleviate this form of water pollution. A third externality is caused by the release of ammonia into the air leading to air pollution, such as acid rain, and odor problems—a problem in heavily concentrated areas, such as large feedlots.

Studies indicate that consumers are willing to pay for environmental protection, (e.g., Carson & Mitchell, 1986). In such a situation, there would be an incentive for the producer to internalize the externality and assume the cost of environmental protection. But with regard to the production of livestock products, consumers, as well as producers, have imperfect information regarding the associated hazards (Portney, 1990). Not knowing that the environmental problems are brought about by the aggregate impact of all producers in a watershed, an individual grower may not be aware of the environmental liability associated with producing the product. The price paid to the producer by the integrator or processor is the same regardless of whether or not animal wastes are handled properly. When sold in the marketplace, the good conveys no information an informed choice affecting his or her demand. The consumer is unwilling to pay more for a item unless he or she has certainty that it combines the attribute of environmental protection. Thus, the marketplace is unable to convey signals to the producer regarding consumer preferences that could ultimately affect how animal waste is handled.

ORGANIZATION OF THE INDUSTRIESPOULTRY INDUSTRY
Many companies in the poultry industry are vertically integrated. Their size allows them to purchase inputs in bulk and to take advantage of economies of scale. The centralization of decision-making allows coordination of production capacity at each stage of production to guarantee a timely supply of a standardized product of uniform and high quality that can sell at a favorable price ensuring dominant market share. Such coordinated systems have the additional benefit of allowing for more rapid adoption of improved production technology, development of new advances, and quicker response to changing consumer needs (Rogers, 1980).

Large integrated firms contract out much of their production to farmers who live not more than 25-30 miles from their processing plant (Heffernan, 1992). The contract farmer owns the land and buildings of the grow-out operation and provides the necessary labor and electricity. These contract farms are served by a company’s hatchery and feed mill. About 97% of all broilers are produced under some form of formal vertical coordination, the remaining are raised by independent producers for niche markets (Rogers, 1980).

The purpose of the contractual arrangement is to form a minimum guaranteed payment for the grower, which often is adjusted based on feed conversion, mortality, and other factors. It enables individual producers to move from a simple credit financing and open-market production to a variety of contractual agreements
By enabling growers with minimal funds still to play a role as the industry increasingly move to large-scale operations, in which few firms compete, the risk associated with production is reduced. With limited financial resources, they are unwilling and often unable to obtain the production capital through traditional sources and to bear the market risks associated with entering the broiler or egg markets (Benson & Witzing, 1971; Reimund et al., 1981). By turning to these input suppliers for their financing, they have an alternative source of production capital and a means to shift a substantial part of the financial and market risks to the contractor.

Contracts can differ in four ways: 1) the degree to which both parties participate in management during the production process, 2) the method of payment for the product or service produced, 3) how risk and profits are shared, and 4) whether one or both parties supply resources used in production (Mighell and Jones, 1963). These contracts by nature are for a short period of time. The length of time depends on the individual contracts between company and grower.

The contract is also seen as a way to reduce the risk and the amount of capital needed by the company since it does not have to invest in growout and breeder facilities. Contracting provides a steady flow of birds for the company. Were integrators to shoulder all the risks, building their own laying and growout facilities, as has been seen in the egg industry, may be the preferred alternative. Because there is low investment and little financial risk to growers, the entry cost of providing the service to companies is low. With the pool of potential growers available to companies likely to be relatively large, companies can pay relatively low fees for the service. A small number of companies do, however, offer risk/profit sharing which enables growers to cover the additional expense of disposing of poultry in an environmentally sound way.

A base price to be paid per pound or per bird produced. A minimum bird weight may be required. Often premiums are based on the grower's efficiency and are then added to the base rate the grower receives. With turkeys, the production tends to follow the broiler pattern with conventional lending rather than work under contract.

In the production of eggs, contracting is less frequent, though it still dominates total production, as sixty percent are produced under contractual arrangements (Haynes, 1982). The contracts specify that the pullets, feed, medicine and field services are furnished by the company; the producers furnish the housing facilities, electricity, and labor. The eggs belong to the company and the producers are paid on the basis of the number of eggs produced, with bonuses for efficient performance. Either party can terminate the agreement.

The responsibility for waste management differs among the broiler, layer, and turkey industries; among contract, independents, and company owned farms; among companies themselves; and among companies contracts with growers. Since many of the layer operations are company-owned, the company is responsible for the waste. Some broiler companies have written into their contracts that ownership of the dead birds and manure is the grower's responsibility. In this case, the grower generally sells the manure or gives it away. Some of these companies have chosen to share the responsibility of the dead birds with their growers by underwriting the expense of collecting dead animals. The responsibility for the manure in all operations is the grower's, be he a contract grower, independent grower, or a company.

**DAIRY INDUSTRY**

The dairy industry is also consolidating. The total number of cows in the US declined by over 50 percent between 1930 and 1988, from 22.2 million to 10.2 million, while total annual production rose from 100 billion pounds to 146 billion pounds of milk (Jones et., al citing USGAO, 1990).
With this concentration of number of producers, farms have become larger and more specialized.

However there are many different types of producers. The typical dairy is a small proprietor-operated dairy that has sufficient enough acreage to raise most of the feed supply and the dairy herd replacements. In 1992 the average herd size in the dairy records program was 88 cows (USDA, 1993) There are however many regional differences. Traditional single family proprietorship is the main form of dairy farm organization throughout the United States. These producers grow their own feed and apply the manure that is produced as a crop and pasture fertilizer (Jones et al, 1993). Nevertheless, in the Corn Belt, South West and South East partnerships are growing in number and corporate specialized farms are common in the North East, Lake States, South West, and North and Central Regions. These large producers purchase much of their feed requirements and are growing pasture and crops merely as a by-product of waste application to their fields (Jones et al, 1993 citing TIAER, 1992). The California dairies have been able to increase their herd size from 375 to 450 cows because of economies of scale (Jones et al, citing Matulich, 1978).

The structure of the dairy industry differs, however, from the poultry industry in that many dairy farmers sell directly to milk procurement agencies--dairy cooperatives--as opposed to contracting with an integrator. Milk tends to be bought from the producers through contracts with the procurement agencies, which control milk marketing not production technology. These market-specific agreements set prices and quantities of milk that is purchased. The advantage of these arrangements are that they reduce the risk to both the milk procurement agency and the producers while cutting transactions costs. The advantage to the producer comes in the form of ready markets, reduced marketing costs, and lower price uncertainty. At the same time, the farmer keeps agency gains from having risk and uncertainty reduced through stable supplies of raw materials bought at the predictable prices.

**Waste Management Roles** - Dairy cooperatives currently market more than 80 percent of the US milk supply (K. Ling, et al., 1995). Production decisions, however, are in the hands of dairy farmers, not agricultural marketing cooperatives. Contracts between producers and cooperatives provide no means of control by the cooperative over the volume of production [A. Manchester, 1992]. The firm buying from that cooperative, on the other hand, is under no such obligation to accept supplies.

At the present time, the manure disposal is the responsibility of the individual farmer. In most cases these farmers have adequate land for the disposal of their waste, with the exception to the large dry lot producers and areas where there are a large number of animals of all types and limited crop land. This can create a problem because the capital costs of an environmentally acceptable manure storage system for a herd of 50 milk cows can range from $10,000 to $85,000 (Milne, 1990). This cost does not include the field application equipment. Small producers do not necessarily have the capital to invest in such a system because of the difficulty of obtaining loans given that they are a greater risk compared to larger farmers (Pagano, 1994).

In addition to these costs associated with environmental management, the dairy market is profoundly affected by regulations, which include local health regulations, milk orders, seasonal pricing, and quotas. As these economic pressures grow, they could have a considerable influence on contracting. These pressures come from lower long-run costs of production resulting from economies of scale, ease the introduction of new technology, and enhance "market power" in contract negotiations. While both the dairy and the poultry industries use contracts to reduce transactions costs, there are several major differences in the contracts and other structures found in the industry.
The pork industry is consolidating into fewer producers, who have close links with pork processors. In 1934 and 1935, only about 60 million hogs were produced in the US. In 1943, pork production nearly doubled from its 1934 level to 122 million (Bundy et al, 1984), but settled down again after World War II. Gradually production has begun to grow again until, in 1990, 95.1 million head were produced (Feedstuffs, 1991).

During the past two decades, the number of farms has dropped from 900,000 to only 250,000, while the total volume of pork production has increased. (Feedstuffs, 1991). Much of this increase has been due to the use of confinement feeding and farrowing throughout the year (Bundy et al, 1984), as well as the move towards more integration within companies. In 1970, the average operation had 77 hogs; in 1993, the number was 241 (Center for Agricultural and Rural Development (CARD), 1994.) Though nearly half of all hogs were produced in small herds of fewer than 500 in 1970, in 1992 the number fell to one-third. The industry is moving towards fewer farms in the mid-size range, and a greater number of large operations. The percentage represented by small operations has remained fairly steady, though they account for a smaller percentage of sales (CARD, 1994).

Swine operations and grain production have traditionally gone together. Thus, it is no surprise that pork production has been concentrated in the feed grain production region of the Midwest, with one-quarter of all production occurring in Iowa. Though fewer farms are producing hogs, the regional distribution of hog production has remained nearly unchanged in 40 years (CARD, 1994). The six leading pork producing states, accounting for 63% of marketed hogs, are Iowa, Illinois, Minnesota, Missouri, Nebraska, and Indiana and all are located in the Midwestern Cornbelt (Feedstuffs, 1991). About 20-30% of the corn grown in these states is fed to hogs.

Vertical Integration - The pork industry has been going through a process of vertical integration similar to the poultry industry. The move towards integration is a reflection of many circumstances. Barkema and Cook (1993) cite three trends that have occurred. First, consumers have become more discriminating thus requiring the pork industry to design their products carefully. Second, the new technology that is being used to overhaul the pork industry to meet the consumers' demands is expensive and economies of scale make it more affordable for the larger producer. Third, a competitive market structure has improved the flow of information between consumers and producers ensuring that pork products are designed to consumers tastes.

Part of the move towards integration has been to capture the economies of scale associated with large scale production. Vertical integration also enables the industry to have better control of the risk. The restructuring of industry has reduced production costs which in turn has led to increase in size and hence further consolidation of the industry. Today the average production costs on farms producing 10,000 hogs annually are nearly 330% lower than costs in small farms producing only 140 hogs a year.

Purpose of Contracting - An increasing number of hogs are produced under contract with pork processors or are owned outright by the processors. This has resulted in tight marketing linkages between the producer and processors. From 1980-1990 the percentage of the nation's hog production under contract or vertical integration doubled to around 10% (Manchester, 1992). Other data show that up to 16% of the nation's hogs were produced under contract or vertical integration in 1991 (Rhodes and Grimes, 1992). The contractual arrangements between hogs farmers and processors are rapidly taking the place of open production in the pork industry.

Typical contractual arrangements involve farmers
entities other than the owner of the feedlot, who generally considers manure a waste, and partly because of landowner concern about odor and problems of weeds introduced by the manure, the manure generated by the feedlots tends not to be utilized as fertilizer (Power, 1994). Thus, manure from the feedlots tends to be applied to land, though there is growing interest in its composting.

Contracting between packer and feeders is also becoming more prevalent in the cattle industry (National Cattlemen's Association, 1995). The Packers & Stockyards Administration states that captive supplies (inventories controlled by packers) averaged 18.7% in 1994.

CURRENT FEDERAL POLICY ON LIVESTOCK WASTE MANAGEMENT

In the United States, the Federal Water Pollution Control Act of 1972 authorizes the United States Environmental Protection Agency to regulate "concentrated animal feeding operations (CAFOs). CAFOs, which require a permit, are defined as point sources that discharge to waters of the U.S. during storms of lesser magnitude than the event of a 25-year/24-hour storm, and that 1) have more than 1,000 animal units or 2) have more than 300 animal units and discharge directly to waters of the United States. Additionally, a facility of any size may require a permit if it contributes significantly to pollution of any surface water. The language has been interpreted by EPA as applying only to discharges to surface waters and not to ground water. Hence land application where there is no surface water runoff is not covered by the law.

Most states have been delegated the authority to carry out the permitting program. Though states develop and implement their own programs, these programs have to be approved by EPA in order to receive EPA funds. Most states view feedlots not discharging into surface waters as complying with a general permit or not even requiring one. In 1993, EPA Region VI developed a general feedlot

BEEF CATTLE INDUSTRY

Over 25 million head of cattle are fattened in feedlots each year. Two-thirds of the production occurs in the five states of Nebraska, Texas, Kansas, Colorado, and Iowa (Power, 1994). Over the past 30 years, beef feedlots have evolved into very large operations with capacities of 1,000 to 50,000 (Vanderholm, 1994). In the major cattle feeding states of the Great Plains, feedlots are generally located near grazing lands or land used for the production of crops, such as corn, wheat, sorghum, and soybeans.

The vast majority of commercial feedlots (as opposed to farm feedlots) purchase almost all the feed. Several of the larger feedlots are owned by large grain-feed companies, such as Cargill, which also own beef packing companies (B. Marion, 1986).

It has been estimated that there is over 32,000 ha of farm land within a 10 km radius of each feedlot. But
permit for states in its region which overrides the state permit approach.

Any potential source of pollution not covered by the permit system is considered a nonpoint source. States are given great flexibility in developing nonpoint source management programs. Most programs rely on voluntary compliance. States, however, with lands in coastal areas are, under the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA), required to develop more stringent, enforceable, programs in critical areas. The mandatory measures include appropriate, management practices that are at least as effective as those listed as "economically achievable" in a guidance document. These management measures apply also to land application of animal waste.

The Clean Air Act, as amended in 1990, requires that states develop and implement programs to meet federal ambient air standards, such as for ozone or particulates, which are developed by EPA. The 1990 amendments extended regulatory oversight to smaller sources, such as feedlots. These new regulations are only now being developed.

**POLICY IMPLICATIONS**

The discussion of the structure and organization of the poultry, dairy, pork, and beef cattle industries should explain in large part why there has been only limited success with the current voluntary approaches to addressing the externalities of water and air (including odor) pollution from these industries. Where there is concentration of large numbers of animals in a geographic area, usually around a large processing facility in the case of poultry or pork or within the confines of a milk marketing order, there is a significant financial cost to handling animal waste in an environmentally sound manner. For the smaller producer, the cost tends to be more burdensome than for the larger, though this clearly depends upon the indebtedness of the producer. The individual producer generally cannot pass this cost onto the buyer of the goods, the vertical integrator or processor, unless all (or most) producers within the production region also choose to internalize the environmental costs--a situation that economists refer to as the "prisoner's dilemma." The latter, however, who generally has a large pool of potential producers with which to contract, has the option of whether or not to purchase or contract with any individual producer. Hence, an individual producer who chooses to internalize the environmental cost puts himself at financial risk; he must absorb these costs himself--in lieu of government cost-sharing programs.

Should there be a premium that consumers will pay for poultry, dairy, pork, or beef products that are produced in ways that are more environmentally sound, the individual producer cannot necessarily garner this premium without incurring the substantial transaction cost of advertising. Even so, without objective assurance that the producer really is "green," consumers may not be willing to pay an additional amount over the "non-green" product.

The customary solution to the prisoner's dilemma in policy analysis is government regulation whereby rules on the handling of animal waste are imposed upon all producers. The Dutch, for example, have rules requiring that all excess animal waste from more than a given number of animals relative to cropland, be deposited at a central manure depot--a manure bank. In addition, a tax, though small, is also imposed once the animal-land ratio has been exceeded. However, enforcement of both regulations has been spotty. The revenue from this tax is used to support research into solutions for animal waste.

A recurrent criticism of blanket regulation of all producers is that it generally falls more heavily upon smaller producers. Because of concern about further concentration of the industry, regulation at the federal and state levels of small or even moderate size producers is politically difficult.
The administrative cost of enforcement is also very high—there are many individual producers, but few inspectors. The European experience suggests that, even where violations have been identified, they are rarely prosecuted. Local administrative bodies upon which the responsibility for enforcement has been delegated, are not likely to impose fines or force compliance where rules are seen as representing a cost to a community and benefits accrue primarily to people outside the community. Likewise this situation occurs in all countries and when governments look at the issue of developing regulations for producers it is important that they look not only into who is accountable for those regulations but also the cost of ensuring that accountability.

In highly vertically integrated systems, it is easier to internalize the cost of environmental protection and ensure compliance at the level of the processor rather than at the level of the producer. By holding the processor who contracts for livestock production or products responsible, in part, for environmental problems that arise throughout production, the processor faces the incentive to internalize the true cost of production. The government administrative cost of enforcement is greatly reduced since there are fewer entities to oversee. And the processor or vertical integrator is better able to pass on the environmental costs of production to consumers. Waste management, in the current context of vertical integration, shifts from being solely an on-farm problem to a problem of the production system that includes the processing plant and the individual livestock production units, or farms.

Where he or she is accountable for negative externalities as well, the vertical integrator or processor is more inclined to take into account the adequacy of disposal opportunities and can consider a greater number of options, including the siting of processing plants. Other options include methods for destroying nutrients, opportunities to export them to other areas, utilizing nutrients in other

may, for example, consider lower plant processing throughput capacity in order to limit the number of animals and hence the amount of animal waste produced. Decisions at this level are more likely to lead to an economically efficient economic solution that meets environmental constraints set at a regional basis.

And making the processor or vertical integrator responsible, which in today’s economy is often a very large national or international corporation, can serve to level the playing field for producers in various political jurisdictions which seek these contracts. The contractor faces the same environmental responsibilities regardless of what state or political jurisdiction his or her contract producers are located.

In effect, the policy stipulates that the owner of the animal is legally responsible not just for the positive externalities associated with production or management of the animal, but also the negative externalities. If the vertical integrator owns the bird that is raised by a contract grower, then he or she also owns the byproducts of the animal. The vertical integrator can legally protect himself or herself from liability for improper management by the contract producer by detailing the manner in which the waste is to be properly disposed. Environmental problems associated with waste management would represent a breach of contract. The contract can show alternative arrangements whereby the grower assumes ownership of the byproducts only if the grower can show that he or she can maintain the positive value of the byproducts through onsite use or offsite market arrangements.

The far lesser integration of the dairy industry suggests that the responsibility for the problem of animal waste cannot be easily passed onto the processor. Furthermore, raising the cost of production to meet environmental regulations would cause the demise of many marginal producers whose total revenue is not sufficient to absorb extra costs. Forcing them to do so would accelerate current trends towards larger, better capitalized
operations unless small producers cooperate in sharing the costs of waste disposal. Thus, in the dairy industry, the social cost of direct regulation may not be acceptable. A more novel approach may be in order. For example, certification for environmentally sound waste management, the creation of a special "green" grade coupled with a higher minimum price support level, and the creation of special "green" dairy labels to allow differentiation in the marketplace that would allow for any consumer premium for "green" dairy products to be passed onto producers (Texas Institute for Applied Environmental Research, 1994). Alternatively, the dairy sector could adopt policies analogous to the 1990 Farm Bill Conservation Compliance provisions that tied eligibility to commodity price support to farm plans for reducing soil erosion. In this case, dairy price support would depend upon farm plans for environmentally sound management of dairy waste.

Because feedlots are generally located near ample amounts of land upon which cattle manure can be applied, cattle waste should theoretically retain value as a soil supplement on adjacent pasture and cropland. Hence, there should be economic incentive enough to deal with it in an environmentally acceptable manner. The major hindrances, however, are the lack of understanding by farmers--and feedlot operators--of the nutrient value of manure, particularly as a substitute for chemical fertilizer the failure of cattle feeders to recognize the need to market manure as a soil supplement and fertilizer, which requires the development and maintenance of product quality, and the education and training of feedlot operators regarding practices that improve the quality of cattle manure as a soil enhancer.

ACKNOWLEDGMENTS

We would like to thank Amy Pagano, Fred Woods, and Basil Eastwood for their helpful comments on drafts of this paper. The views expressed in this paper are solely those of the authors and do not represent official EPA policy, nor viewpoints of the senator from North Dakota, Senator Kent Conrad. In addition, the authors take full responsibility for any oversights and errors contained in the article.

REFERENCES


Hayenga, Marvin, Iowa State University. 1995, personal communication.


Manchester, Alden. 1992. Transition in the Farm and Food System, USDA, ERS.


Texas Institute for Applied Environmental Research. 1994. Preliminary Analysis of a Green Milk Program to Finance Environmental Compliance by
United States Milk Producers, prepared for the US Environmental Protection Agency. Unpublished manuscript.


IMPACT OF INTENSIVE LIVESTOCK AND POULTRY FARMS ON THE ENVIRONMENT - EUROPEAN EXPERIENCE

Dr. Hein Korevaar
Reference Centre for Livestock Production
The Netherlands

- From 1978-1990 carried out research on grasslands with management restrictions for nature conservation, and on environmental issues
- 1992-1995 was Head of the Dept of Animal Husbandry and Environment of the National Reference Centre for Livestock Production,

SUMMARY

Animal husbandry has intensified enormously in most Western European countries during the last thirty years. This intensification has led to negative effects on nature and the environment. Much attention is currently being paid to the negative consequences for the environment of nutrient losses from the agricultural production process.

New regulations concerning the handling, application and storage of manure have recently been put into effect in many countries. The targets set by national and European Union (EU) governments are designed to reduce the critical load of minerals in ground- and surface water to ensure good water quality both for human consumption and for maintaining natural ecosystems.

Besides the targets for reducing mineral losses, environmental legislation also includes targets for the emission of acidifying substances such as ammonia. The impact of these targets on farm management practices is tremendous.

Different techniques, such as slurry handling and application and adaptation of animal nutrition, are available to reduce mineral losses. At farm level a combination of measures is necessary.

A high concentration of intensive animal farms in a region will cause severe problems with respect to the excessive manure produced. As the manure cannot be disposed of in that region, it has to be transported further afield. Transferring animals to other regions may be a solution, especially when farmers acquire acreage there that enables them to apply the animal manure on their own fields or where they are able to build up long-term arrangements with arable farms.

Public authorities and farmers' organisations need to work together more closely to develop effective and practical policies both to protect the environment and to promote sustainable and profitable animal production. This approach demands a high level of education on the part of

the farmer. It also requires the help of research and advisory services to develop new tools to support sustainable farming systems both economically and environmentally.

INTRODUCTION

Animal husbandry in the Netherlands, as in most other Western European countries, has intensified enormously in the last thirty years. An increase in the production and quality of roughage, achieved mainly by high rates of fertilization on grassland and a high concentrate consumption per cow have made it possible to raise stocking rates and contribute to a high milk production per cow. The numbers of pigs and poultry have also shown a rapid growth in the Netherlands as well as in some regions of other European countries.

The intensification of animal production has had negative effects on nature and environment. In particular, the high concentration of pigs and poultry in some European regions has brought about severe problems due to high yields of animal manure in those regions. The production of cattle slurry has mostly been more evenly distributed throughout a country. Animal manure is of course a valuable product in agricultural production processes in that the nutrients stimulate plant growth, but not all nutrients released from the organic compounds are used directly by plants. Part of the nutrients is released slowly and sometimes, especially when there are high application rates, there is an excess which is not taken up by plants. An excess of nutrients can result in high losses to the atmosphere or ground- and surface water in the form of ammonia volatilization, denitrification, and leaching and run off of nitrate, phosphorus and potassium. Figure 1 presents a simplified diagram of nutrient flows.

ANIMAL HUSBANDRY IN EU MEMBER STATES

Livestock population has increased rapidly over the last decades in several member states of the European Union. Rates of increase have been the largest in intensive livestock production (swine and poultry). For example, there was a fivefold increase in numbers of pigs in the Netherlands between 1960 and 1990 - from some three million animals in 1960 to about fifteen million animals in 1993.

In several other EU member states, although the total size of the pig population has remained rather stable at the national level, the concentration of pig production has increased, for example in Brittany (France), West Flanders (Belgium), Lower Saxony and North Rhine-Westphalia (Germany) and Lombardy (Italy) (Brouwer and Godeschalk, 1993).

Figure 1. Simplified scheme of nutrient flows at field level
The trend towards an increase in the concentration and specialization of pig production mainly took place in areas close to the major urban centres of Europe with good access to large ports (e.g. Rotterdam, Antwerp, Hamburg, Brest and Le Havre) where feeding stuffs could be obtained at low costs (Brouwer and Godeschalk, 1993).

Among the countries of the ELI, animal density varies widely. Table 1 shows the distribution of livestock (cattle, other grazing animals, pigs and poultry) in 1987 for all EU countries. The total size of the livestock population is presented in livestock units (LU) (Brouwer and Godeschalk, 1993). Animal density (number of livestock units per hectare of utilized agricultural area) is an important factor from an environmental point of view since it is a rough indicator of the amount of animal manure which has to be spread on the fields. High levels of animal density, therefore, usually indicate a surplus of animal manure. It needs to be emphasized that animal density in Table 1 is based on national averages. There is however a wide range in animal density among the

### Table 1. Livestock population (cattle, other grazing animals, pigs and poultry), utilized agricultural area (UAA) and animal density in EU countries in 1987 (Brouwer and Godeschalk, 1993)

<table>
<thead>
<tr>
<th>Country</th>
<th>Cattle (1000)</th>
<th>Oth. graz. animals' 1000</th>
<th>Pigs (1000)</th>
<th>Poultry (1000)</th>
<th>Total livestock 1000 LU</th>
<th>UAA³ (1000 ha)</th>
<th>Animal density LU/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany, F.R.</td>
<td>15231</td>
<td>1329</td>
<td>23989</td>
<td>68696</td>
<td>17552</td>
<td>11843</td>
<td>1.5</td>
</tr>
<tr>
<td>France</td>
<td>21856</td>
<td>11650</td>
<td>11777</td>
<td>224908</td>
<td>23204</td>
<td>280058</td>
<td>0.8</td>
</tr>
<tr>
<td>Italy</td>
<td>8907</td>
<td>9437</td>
<td>8795</td>
<td>144350</td>
<td>11300</td>
<td>15545</td>
<td>0.7</td>
</tr>
<tr>
<td>Belgium</td>
<td>3071</td>
<td>218</td>
<td>5844</td>
<td>23243</td>
<td>3915</td>
<td>1370</td>
<td>2.9</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>217</td>
<td>8</td>
<td>75</td>
<td>99</td>
<td>175</td>
<td>127</td>
<td>1.4</td>
</tr>
<tr>
<td>Netherlands</td>
<td>4895</td>
<td>1083</td>
<td>14349</td>
<td>98669</td>
<td>8016</td>
<td>2024</td>
<td>4.0</td>
</tr>
<tr>
<td>Denmark</td>
<td>2351</td>
<td>134</td>
<td>9266</td>
<td>15540</td>
<td>3967</td>
<td>2798</td>
<td>1.4</td>
</tr>
<tr>
<td>Ireland</td>
<td>6765</td>
<td>5033</td>
<td>911</td>
<td>7844</td>
<td>5773</td>
<td>4915</td>
<td>1.2</td>
</tr>
<tr>
<td>Unit. Kingdom</td>
<td>12087</td>
<td>38529</td>
<td>7899</td>
<td>138918</td>
<td>15830</td>
<td>16750</td>
<td>0.9</td>
</tr>
<tr>
<td>Greece</td>
<td>678</td>
<td>12730</td>
<td>909</td>
<td>29752</td>
<td>2416</td>
<td>3842</td>
<td>0.6</td>
</tr>
<tr>
<td>Spain</td>
<td>5358</td>
<td>23191</td>
<td>12744</td>
<td>125338</td>
<td>11406</td>
<td>24797</td>
<td>0.5</td>
</tr>
<tr>
<td>Portugal¹</td>
<td>1387</td>
<td>3260</td>
<td>2362</td>
<td>31499</td>
<td>2301</td>
<td>3331</td>
<td>0.7</td>
</tr>
<tr>
<td>EU 12</td>
<td>82801</td>
<td>106602</td>
<td>98921</td>
<td>908856</td>
<td>105855</td>
<td>115399</td>
<td>0.9</td>
</tr>
</tbody>
</table>

1. Other grazing animals - mainly sheep and goats
2. Total livestock population in livestock units (LU). Livestock units are a common unit representing the nutrient (energy) requirement of livestock species; e.g. dairy cows are 1.0 LU; breeding sows: 0.5; fattening pigs: 0.3; laying hens: 0.014 and broilers 0.007 LU (CEC,1989)
3. Utilized agricultural area (UAA)
The livestock population in EU countries in 1987 (Table 2), based on livestock units, shows that, in the EU, cattle is the dominant livestock species, followed by pigs. Differences among countries, however, are large. Ireland is a grassland and cattle country. In Greece, other grazing animals (sheep and goats) dominate. The share of the pig population, based on livestock units, is over forty percent in Denmark and the Netherlands.

<table>
<thead>
<tr>
<th>Country</th>
<th>Cattle</th>
<th>Other grazing animals</th>
<th>Pigs</th>
<th>Poultry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany, F.R.</td>
<td>60</td>
<td>1</td>
<td>34</td>
<td>5</td>
</tr>
<tr>
<td>France</td>
<td>68</td>
<td>6</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Italy</td>
<td>54</td>
<td>9</td>
<td>21</td>
<td>16</td>
</tr>
<tr>
<td>Belgium</td>
<td>56</td>
<td>1</td>
<td>37</td>
<td>6</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>89</td>
<td>1</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>44</td>
<td>2</td>
<td>41</td>
<td>14</td>
</tr>
<tr>
<td>Denmark</td>
<td>40</td>
<td>1</td>
<td>55</td>
<td>4</td>
</tr>
<tr>
<td>Ireland</td>
<td>85</td>
<td>9</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>53</td>
<td>24</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Greece</td>
<td>20</td>
<td>58</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>Spain</td>
<td>36</td>
<td>22</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>Portugal</td>
<td>43</td>
<td>17</td>
<td>24</td>
<td>15</td>
</tr>
<tr>
<td>EU 12</td>
<td>55</td>
<td>11</td>
<td>23</td>
<td>11</td>
</tr>
</tbody>
</table>

The livestock population in EU countries in 1987 (Table 2), based on livestock units, shows that, in the EU, cattle is the dominant livestock species, followed by pigs. Differences among countries, however, are large. Ireland is a grassland and cattle country. In Greece, other grazing animals (sheep and goats) dominate. The share of the pig population, based on livestock units, is over forty percent in Denmark and the Netherlands.

**ANIMAL HUSBANDRY IN THE NETHERLANDS**

Animal husbandry in the Netherlands is characterized by its intensity. The increase in numbers of animals has been combined with a reduction in the number of livestock farms. The remaining holdings have specialized in a particular type of livestock. In 1993 there were about 75,000 livestock farms, of which 40,500 stocked dairy cattle with an average of 41 dairy cows per farm and a stocking rate of 1.34 dairy cows per ha of grassland and fodder crops. The average milk production was 6,325 kg/cow/year. The corresponding annual concentrate consumption was about 2,200 kg/cow (including attendant young stock) (Landbouwcijfers, 1994). In 1993 the total population of pigs on about 26,900 farms was 15 million head. On average, farms with breeding sows had 134 sows/farm and farms with fattening pigs (> 20 kg liveweight) had 325 pigs/farm. A total of 96 million laying hens and broilers were kept on 5,350 farms. Most poultry farms specialized in either laying hens or broilers and, per farm, the average number of laying hens was 18,000. For broilers, the average was 31,500 per farm (Landbouwcijfers, 1994).
The substantial growth in production on livestock farms in the Netherlands was made possible as a result of imported feed components. Nowadays, 80 percent of compound feed components come from abroad (CBS, 1993) and the production and consumption of concentrates increased by 350 percent between 1960 and 1990. At the same time, manure production increased by 180 percent. As most holdings with pigs and poultry operate on a small acreage they only have limited possibilities for the disposal of manure on their own farmland (Korevaar, 1994)

ANIMAL HUSBANDRY AT A REGIONAL LEVEL

A study was published recently on mineral flows at farm level in the different countries of the European Union (EU) (Brouwer et al., 1995; Brouwer and Godeschalk, 1995). The objective of the study was to investigate to what extent nitrogen surplus varies across groups of farms. This was based on the hypothesis that the nitrogen surplus increases with the intensity of agricultural production. The data at farm level were based on the 1990/91 sample of the Farm Accountancy Data Network (FADN) of the European Commission (CEC,1989). Table 3 shows the excretion of nitrogen from animal manure and the surplus of nitrogen, both expressed in kg per ha of utilized agricultural area, the animal density per hectare of utilized agricultural area and the proportion of cattle and pigs in the total livestock population of the EC at a regional level. Nitrogen surplus is defined as the difference between the input of nitrogen that enters the farm gate (e.g. fertilizers and concentrates) and the output of nitrogen that leaves the farm via, for example, milk, livestock, sold crops and animal manure that is not used by that farm.

The excretion of nitrogen from animals is highest in the Netherlands and Belgium, closely followed by Catalonia and Galicia (Spain), Brittany (France) and Lombardy (Italy). Animal density in these regions exceeds 2 livestock units per hectare.

Pig production is concentrated in a limited number of regions of Europe. The Netherlands, Belgium, Denmark, Lower Saxony, Brittany and Lombardy account for some 45 percent of the total pig population in the EU and for about 10 percent of the total utilized agricultural area of the EU (Brouwer and Godeschalk, 1993; 1995).

Almost half of the pig population in these regions is located at specialist intensive livestock (pig and poultry) farms operating on small acreages. This implies that the animal manure from these farms needs to be used elsewhere.

POLICY-LEVEL APPROACHES IN WESTERN EUROPE TO THE REDUCTION OF NUTRIENT LOSSES

The governments of many European countries have set a number of targets aimed at a speedy reduction in nutrient losses from agriculture to the environment. The regulations are often focused on the amount and timing of animal manure application and sometimes on fertilizer application in order to reduce nitrate leaching. Despite their common goal, regulations in the various countries have, so far, been far from uniform (Schroder, 1992; Brouwer and Godeschalk, 1995).

The Nitrate Directive (EC 91/676) taken by the Ministers of the Environment in the EU in 1991 is a major step towards achieving a more common approach. The directive includes regulations on how to handle manure and fertilizers in zones which have been identified as vulnerable to the leaching of nitrates. One of the main elements of the directive is that the application of animal manure should not exceed 170 kg of nitrogen per hectare in the so-called vulnerable zones.
Table 3. Excretion of nitrogen from animal manure and nitrogen surpluses (kg per ha of utilized agricultural area), animal density (livestock units per ha of utilized agricultural area) and share (%) of pigs and cattle in the livestock population by country and some regions in 1990/91 (Brouwer and Godeschalk, 1995)

<table>
<thead>
<tr>
<th>Country/region</th>
<th>Nitrogen (kg/ha)</th>
<th>Animal density (LU/ha)</th>
<th>Share in livestock population (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supply from manure</td>
<td>Net nitrogen surplus</td>
<td></td>
</tr>
<tr>
<td>German</td>
<td>98</td>
<td>12</td>
<td>1.5</td>
</tr>
<tr>
<td>Lower Saxon</td>
<td>99</td>
<td>125</td>
<td>1.6</td>
</tr>
<tr>
<td>N.Rhine-W. ph.</td>
<td>113</td>
<td>141</td>
<td>2.0</td>
</tr>
<tr>
<td>France</td>
<td>62</td>
<td>73</td>
<td>0.8</td>
</tr>
<tr>
<td>Brittany</td>
<td>149</td>
<td>133</td>
<td>2.4</td>
</tr>
<tr>
<td>Italy</td>
<td>55</td>
<td>18</td>
<td>0.7</td>
</tr>
<tr>
<td>Lombard</td>
<td>137</td>
<td>92</td>
<td>2.3</td>
</tr>
<tr>
<td>Belgium</td>
<td>196</td>
<td>170</td>
<td>2.6</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>128</td>
<td>121</td>
<td>1.4</td>
</tr>
<tr>
<td>Netherlands</td>
<td>343</td>
<td>321</td>
<td>3.7</td>
</tr>
<tr>
<td>Denmark</td>
<td>109</td>
<td>114</td>
<td>1.5</td>
</tr>
<tr>
<td>Ireland</td>
<td>93</td>
<td>63</td>
<td>1.2</td>
</tr>
<tr>
<td>Unit. Kingdom</td>
<td>68</td>
<td>59</td>
<td>0.9</td>
</tr>
<tr>
<td>England North</td>
<td>88</td>
<td>79</td>
<td>1.3</td>
</tr>
<tr>
<td>Greece</td>
<td>64</td>
<td>46</td>
<td>0.6</td>
</tr>
<tr>
<td>Spain</td>
<td>40</td>
<td>19</td>
<td>0.5</td>
</tr>
<tr>
<td>Galicia</td>
<td>166</td>
<td>68</td>
<td>2.2</td>
</tr>
<tr>
<td>Catalonia</td>
<td>173</td>
<td>96</td>
<td>2.0</td>
</tr>
<tr>
<td>Portugal</td>
<td>40</td>
<td>6</td>
<td>0.5</td>
</tr>
<tr>
<td>EU 12</td>
<td>73</td>
<td>71</td>
<td>0.9</td>
</tr>
</tbody>
</table>
This standard has to be met at farm level by the year 1999 at the latest unless the goals formulated in the directive can be achieved by other means. It is the task of the national governments to identify the vulnerable regions. Several Member States (e.g. Denmark, Germany, the Netherlands and Luxembourg) consider the whole country to be vulnerable (Brouwer and Hellegers, 1995).

Another step to a more common approach has been made by the Oslo and Paris Commissions of the countries around the North Sea (Belgium, Denmark, France, Germany, the Netherlands, Norway, Sweden, Switzerland and the United Kingdom). In these countries, the nutrient load from agriculture represents a high proportion of the total load of nutrients deposited in coastal zones: about a quarter of the total anthropogenic inputs of phosphorus and half of the anthropogenic inputs of nitrogen. Ammonia emissions, which originate mainly from agriculture, represent about 30 to 50 percent of the total emissions of nitrogen to the atmosphere. It has become clear that the agricultural sector is not only the most important contributor to the anthropogenic inputs of nitrogen and phosphorus, but also the most complex sector to handle (Oslo and Paris Commissions, 1993).

Two agreements have resulted from the Oslo and Paris Commissions (PARCOM Recommendation 92/7). The first concerns reductions in each of four categories of nutrient losses:

- ammonia volatilization;
- leaching of nitrogen, mainly nitrate;
- leaching, run-off and losses of phosphorus from erosion;
- farm waste discharges.

The second commits the Contracting Parties to undertake a long list of measures, including financial instruments.

POLICY LEVEL APPROACH IN THE NETHERLANDS TO THE REDUCTION OF NUTRIENT LOSSES

Ways of reducing nutrient losses due to ammonia volatilization have received more attention in the Netherlands than in other countries.

The following targets for nitrogen in the year 2000 have been laid down in the Netherlands (LNV, 1990; 1993):

- in areas where groundwater can be used for drinking water, which means water with a salt content $< 150$ mg Cl\(^{-}\) per litre, the nitrate concentration must be less than 11.3 mg NO\(_3\)^{-}N/L at a depth of 2 m below groundwater level;
- total N concentration in stagnant surface waters must not exceed 2.2 mg N/L;
- the total N emission to the North Sea must be reduced to 50 percent of the 1985 level by 1995;
- ammonia volatilization for the whole country must be reduced by 70 percent of the 1980 level.

For phosphorus, the targets in the year 2000 are (LNV, 1990; 1993):

- fertilization with P will gradually be restricted to a level where the P applied equals the uptake by the plant, including some inevitable losses;
- P concentration in stagnant surface waters must not exceed 0.15 mg P/L;
- the total P emission to the North Sea must be reduced to 50 percent of the 1985 level by 1995.

Environmental policies concerning agriculture have been in operation in the Netherlands since 1987 and can be divided into three phases:

FIRST PHASE 1987 TO 1990: STABILIZATION

This phase consisted of measures to control manure production. Increased manure production was
only allowed where farms were large enough to use all the manure they produced on their own fields. In addition, there were restrictions on the manure application rate and on the time and method of its application. The maximum permitted application rates were gradually decreased. Manure spreading was forbidden during some winter months and also on frozen soil or soil covered with snow.

SECOND PHASE 1991 TO 1994: FURTHER REDUCTION

In this phase a further reduction in the manure application rate and a longer period of non-application of manure in winter was specified. In addition, in Spring the slurry had to be applied using machinery which deposited it directly into the soil (e.g. by injection), thereby preventing the volatilization of ammonia. Emphasis was also placed on stimulating a lower mineral input by fertilizers, on adapting feeding strategies and on optimizing feed composition. Techniques and strategies were to be developed to enable better storage, handling, processing and distribution of manure. For example, a lot of manure is now transported for application in regions with arable farms.

THIRD PHASE 1995 TO 2000: EQUILIBRIUM

Beginning in 1995, the targets are being tightened further. The goal will be to achieve an equilibrium situation for both phosphorus and nitrogen. During this phase, the approach will change from the present system based on a set of uniform restrictions for the whole country to a set of basic environmental targets in combination with individual options appropriate to specific farm circumstances. Central to this approach will be the introduction of a mineral balance as a management and accounting instrument. At farm level, all the inputs and outputs will be registered in the same way as a farmer operates his financial accounting system. If the mineral balance records a surplus of minerals above the allowable level, the farmer will have to pay a levy for the surplus quantities of P, N and NH\(_3\). A mineral accounting system will give the farmer greater flexibility and incentive in mineral management and will encourage him to identify economical solutions specific to his own farming situation.

AN INTEGRATED FARM-LEVEL APPROACH TO THE REDUCTION OF NUTRIENT LOSSES

Different techniques are available to reduce nutrient losses substantially. For dairy farms, Korevaar and Den Boer (1990) described the effect of different measures on the nutrient losses and ammonia volatilization at farm level:

- adaptation of animal nutrition to reduce the level of minerals in the manure excreted;
- disposal and transport of manure to arable farms;
- disposal of manure to manure processing plants producing high quality dry manure pellets which can be sold abroad;
- finer balancing of fertilization with crop uptake;
- systems for applying animal manure with low ammonia volatilization;
- systems for handling and storing manure with low ammonia volatilization;
- systems for animal housing with low ammonia volatilization;
- restriction of grazing (to a part of the day);
- adaptation of crop cultivation techniques.

For pig and poultry farms, biggest effects on reduction of nutrient losses and ammonia volatilization may be expected from measures concerning:

- reduction of N- and P-excretion per animal by adapting feed rations and feeding strategies;
- systems for handling and storing manure and for animal housing with low ammonia volatilization;
- disposal and transport of manure to arable farms and disposal of manure to manure processing plants producing high quality dry manure pellets for export

On a farm scale, a combination of measures is necessary to meet the targets on nutrient losses.
set by the government. These measures cannot stand alone but have to be geared to each other in an integrated system. For example, by covering a slurry store, ammonia emission from the store can be reduced by 50 to 90 percent. Unless the slurry is applied using a low emission technique, for instance injection, the ammonia retained by covering will volatilize after application. The availability of the nutrients for plant growth will increase after injection. Without adequately decreasing the subsequent nitrogen fertilizer application, N leaching will increase (Korevaar and Den Boer, 1990). For this reason, different packages of measures have to be developed depending on the situation on different farms.

A mineral balance gives a good impression of the difference between N- and P-input and output at farm level. The difference (N- and Psurplus) is a potential source of losses to the environment. Surveys at farm level indicate that, on dairy farms, a reduction of the mineral input by fertilizers and concentrates is relatively easy to realize by a better application of animal manure and a better utilization of grass and other roughage from the same farm. The surplus of N on a mineral balance can be reduced by 25 to 50 percent within a couple of years (Korevaar, 1994)

THE ‘BASIC’ ENVIRONMENTAL PACKAGE

The environmental aims of this package are to achieve a maximum nitrate concentration in groundwater of 50 mg per liter; a maximum phosphate surplus of 2.8 kg per ha per year and a maximum ammonia deposition of 1,000 acid equivalents per ha per year.

THE ‘NITRATE’ ENVIRONMENTAL PACKAGE

This package is the same as the ‘Basic’ package except that the target for the maximum nitrate concentration in groundwater is 25 mg per liter.

THE ‘PHOSPHATE’ ENVIRONMENTAL PACKAGE

This package is the same as the ‘Basic’ package except that the target for phosphate surplus is a maximum of 25.6 kg per ha per year.

THE ‘AMMONIA’ ENVIRONMENTAL PACKAGE

This package is the same as the ‘Basic’ package except that the target for the maximum ammonia deposition is a maximum of 600 acid equivalents per ha per year.

As a result of market influence, the increase of production level per head (e.g. an increase of milk production per cow from 6,500 kg/year in 1990 to 8,500 kg/year in 2005), and the current policies on animal health and welfare and on environmental regulations, we expect in the year 2005 compared with 1995 a reduction in animal numbers from ‘autonomous developments’:

- 35 percent for dairy cattle
- 25 percent for beef cattle and sheep
- 25 percent for pigs (breeding sows and fattening pigs)
- 20 percent for laying hens
- 0 percent for broilers.

The results of this study indicate, that if the ‘Basic’ environmental package is applied, dairy husbandry as well as pig and poultry farms will become increasingly dependent on available land compared with the present situation in the Netherlands.

STUDY ON ANIMAL HUSBANDRY AND THE ENVIRONMENT IN THE NETHERLANDS

In 1994 the Animal Husbandry and Environment Department of the National Reference Centre for Livestock Production published a study on the significance for the Dutch livestock sector of the environmental targets for soil, water and air (Berghs and Van der Ham, 1994). Various Dutch government policy memoranda describe agreed and proposed targets. The impact of combinations of these targets on the livestock industry during the next 10 years is outlined in the survey. We have called these combinations ‘environmental packages’.
Dairy farms will try to gain enough land to become self-supporting in roughage production, thereby ensuring that their entire manure production can be applied on their own fields. Fertilizing, feeding and feed rations will be further optimized to meet environmental targets. A high milk production per cow will be realized with a minimum of mineral input. In all areas, subsoil manure application (e.g. slurry injection) and covered manure storage will be needed to minimize ammonia volatilization. In addition, in the most intensively utilized areas on sandy soils, low-emission livestock housing will be required.

Pig farms will also try to increase their interaction with the land, but this will take place more on a regional or national level. Not every pig farm will have enough land to dispose of its own manure. Manure will be disposed of on arable farms, whether or not in exchange for feed crops such as corn-cob mix or cereals for the pigs. The extent of land interaction in pig production, as well as the total number of pigs in the Netherlands, will strongly depend on the success or failure of establishing large-scale manure processing plants. Under this scenario, the amount of pig and poultry manure that will have to processed and exported will amount to 35,000 tons of phosphate. If pig slurry can be affordably processed and the product (e.g. dry pellets) exported, there will be no need under this environmental package to reduce the total number of pigs. Should the attempt to establish a manure processing industry fail, then the total number of pigs will have to reduced by a further 25 percent. In this case the total decrease will be 50 percent compared with the 1990 level.

Because of their dry manure, poultry farms clearly have an advantage over other farms. Rapid drying of manure strongly reduces the ammonia volatilization and dry manure can be disposed of relatively cheaply, also abroad. The 'Basic' environmental package will not bring about a greater reduction in poultry numbers than the reduction from 'autonomous developments' described above.

The effects of the 'Nitrate' environmental package differ from those of the 'Basic' package, particularly in the sandy areas. Under the 'Nitrate' package, the cultivation of maize on well-drained sandy soils will be very difficult or even impossible and this will have far-reaching consequences for farms on these soils. On dairy farms in these areas, only low levels of nitrogen fertilization (less than 200 kg N/ha/year) will be possible on pasture grass. Consequently, an additional 15 to 30 percent of the acreage will be needed to meet feed requirements. In addition, the disposal of manure on arable farms on sandy soils will be greatly reduced, which will mean that an extra amount of slurry (10,000 tons phosphate) will have to be processed industrially and exported to prevent an otherwise inevitable further reduction in livestock numbers.

If the 'Phosphate' environmental package is applied, on dairy farms it will no longer be necessary to calculate fertilization, feeding and feed rations so accurately. Farms which are not self-supporting in roughage production due to a lack of land will be able to purchase the required roughage and still use their own manure. The additional disposal of pig and poultry manure on arable farms will depend on the arable farm owner's level of acceptance. Industrial processing of manure will not be required if arable farm owners are prepared to accept an additional amount of phosphate and if the poultry manure is exported directly.

Under the 'Ammonia' environmental package it will be impossible to retain the herd sizes mentioned under 'autonomous developments' and the 'Basic' package. Housing systems with low levels of ammonia emission will be needed in almost all areas. The maximum ammonia deposition target of 600 acid equivalents per ha per year will necessitate a tremendous decrease in herd sizes in the southern and eastern parts of the Netherlands where animal density is the highest and where the vegetation on the sandy soils is very vulnerable to acidification. As a result of this tremendous decrease in herd size, there will no longer be a manure problem, as it will be possible to use all
The policy of the Dutch government is gradually changing from a strict set of uniform restrictions for the whole country to one in which basic targets are combined with individual options which enable farmers to develop an optimized package of measures specific to their own farming situation. This approach demands a high level of education on the part of the farmer, including a good knowledge of environmental issues. It also requires the help of research and advisory services to develop new tools, such as computer-simulated farm management programs, to support sustainable farming systems both economically and environmentally.

RECOMMENDATIONS BASED ON EUROPEAN EXPERIENCE

The study on animal husbandry and the environment in the Netherlands (Berghs and Van der Ham, 1994) was made in order to investigate specific Dutch circumstances, but it points to some general conclusions for other countries. Even under favourite (soil and climate) production conditions, a concentration of intensive animal farms in a region with an average animal density higher than 2 livestock units per ha will cause severe problems because the excess manure produced cannot be utilized in that region and must be transported elsewhere. In such a region, damage to nature and human health may be caused by acid rain, ammonia deposition and the contamination of groundwater - a potential supply of drinking water - by nitrates.

Transferring animals to other regions may be a solution, especially when farmers are able to acquire there enough acreage to apply the animal manure on their own fields or to make long-term arrangements with arable farms for the disposal of their manure, whether or not in exchange for feed crops.

In addition to setting targets for the reduction of mineral losses, environmental legislation should also include targets for the reduction in the use of pesticides, the emission of acidifying substances such as ammonia and the reduction in man-induced draught.

To reduce nutrient losses substantially, different techniques are available. Measures to reduce losses have to be integrated and good farm management is necessary. Public authorities and farmers’ organisations should work more closely together to develop effective and practical policies both to protect the environment and to promote sustainable and profitable animal production. The

phosphate from the remaining livestock and poultry on the grassland and arable fields.

REFERENCES


SITING LIVESTOCK & POULTRY OPERATIONS CANADIAN PERSPECTIVE

Bob Robson
Shur-Grain Research Farm
Burford, Ontario

Responsible for facility design and siting of 190 animal unit facility (Dairy & Swine 1984) to resolve rural/urban conflict
Responsible for facility design and siting of new 370 animal-unit Research facility (Dairy, Swine & Poultry) 1990

In Canada last year (1994) we produced grains from about 62,000,000 acres. In Canada last year (1994) we produced about 4,500,000 animal-unit equivalents of livestock and poultry. In Canada, last year, at maximum recommended rates of manure application, we needed about 2.5 million cultivated acres to properly utilize the manure we produced. In Canada, last year, we had enough seeded acres to handle almost 25 times our actual manure production from the livestock and poultry we raised.

A CANADIAN PERSPECTIVE COULD WELL BE "SO WHAT'S THE PROBLEM?"

The problem(s) we have in Canada arise because 60% of our pig production, 74% of our poultry production and 78% of our milk production is in 3 Provinces - B.C., Ontario, Quebec - which have high concentrations of expanding urban populations. This is not to say there are no problems, past or future, in the other Provinces. However, the accelerated rate of urbanization in the three Provinces mentioned, coupled with the resulting changes in both social attitudes (several generations "removed from the farm") and rural political influence (the farm votes are proportionally so few that they cannot elect a candidate), are reason to lump them together.

WHAT NOW, N CANADA, ARE THE PRESSURES WHICH INFLUENCE THE WAY WE WILL APPROACH SITING LIVESTOCK AND POULTRY OPERATIONS IN THE 21ST CENTURY?

DEMOGRAPHIC PRESSURES

In Ontario, 50 years ago, rural farm population and rural non-farm population were equal. To-day rural farm population is 25% of the 1945 figure and rural non-farm population has doubled. The rural non-farm to farm population ratio is now about 8.5 to 1. In most cases, the new "Ruralites" are well-educated and financially comfortable. They are also well-connected, and are both willing and able to pull political strings.

N.I.M.B.Y. PRESSURES

An offshoot of demographic changes described previously involves Ruralites who want a country
lifestyle without agricultural odours, dust or noise in their backyard. A case in point is probably why I'm speaking to you to-day. In 1982 our local Town Council approved a 600-home subdivision plan on land adjacent to our farm (and 200-sow liquid manure pig operation) with separation distances much less than those advised by our Provincial Ministry of Agriculture. In late 1983 people began to occupy their new homes. In spring 1984 people opened their windows to "fresh country air" The following day a 600-strong Ratepayers Association was formed to lobby town council and Ministry of Environment "to put an end to this offensive smell". The problem was resolved, out of court, at a cost shared equally by us, the Municipality and the land developer.

ENVIRONMENTAL PRESSURES

! Extensive livestock and poultry operations
! Extensive livestock and poultry operations sited exclusive of an on-site (or adjacent) crop production program- With such operations, manure has been/is considered a disposal problem, not a soil nutrient source.
! Encroachment--past, present, future, of non-farm dwellings, singly or in number.
! Inadequate or substandard manure storage facilities.
! Improper manure spreading practices--lack of attention to details of timing, incorporation, application rates, watersheds etc.
! It is very possible that our environmental agenda will be scrutinized by trading partners on a world-wide basis and could influence whether or not some classes of Canadian agricultural products are acceptable. While siting of operations is probably not a major concern in this area, other environmental practices could be. These might include manure handling and manure management, safe pesticide use, disposal of farm wastes, disposal of deadstock etc. Non tariff barriers to trade based on deviations from a sound environmental farm plan are within the realm of possibility.

PRESSURES FROM EXPANDING AND NEW OPERATIONS
The norm for new swine operations in multi-site arrangements is 500 sows or 2000 weaners or 1000 grow-finish pigs per site. New or expanding dairy operations are 100 cows or more per site. Depending upon the site of available cropland, such operations may put pressure on manure management. Perceived problems, related to odours, have also stopped construction of new operations even when distance codes and manure management recommendations have been met. Rural neighbours have successfully lobbied at least one Ontario municipal council to deny a building permit for a large swine operation. Bigness is a threat!

POLITICAL PRESSURES
In most areas of Canada, municipal governments issue permits for construction of new farm buildings. Most municipal governments lack the expertise necessary to properly assess the impact of proposed new livestock facilities and rely on Provincial Ministries for advice and direction. In too many cases, sound technical direction is disregarded by municipalities and local decisions are influenced by such factors as effective lobbying, patronage and fear of the unknown.

FUTURE - WHERE ARE WE HEADED IN CANADA WITH RESPECT TO SITING LIVESTOCK AND POULTRY OPERATIONS FOR THE 21ST CENTURY?

SHORT TERM
New laws, new regulations, new guidelines, new formulas are being developed and implemented by many Canadian provincial Ministries. The next three speakers will be discussing these topics in their presentations.

LONG TERM
A respected international livestock (pigs) consultant recently stated that we will witness a shift in animal agriculture from areas of dense human population to the plains of the world. I agree with his assessment and I believe that we will see this shift happen in Canada, within one generation.
BRITISH COLUMBIA APPROACH TO SITING LIVESTOCK AND POULTRY OPERATIONS

David J. Sands
B.C. Ministry of Agriculture and Food Abbotsford, British Colombia

Since 1983, is the Greenzone Administrator with the B.C. Ministry of Agriculture, Fisheries and Food
Responsible for working to solve urban/rural conflicts; the development of "right to farm legislation"
Involved with implementation of new Farm Practices Protection

Farming is dependent upon the environment and maximizes the use of the soil, water, air and sunlight for agricultural production. While the farmers have the need to "manage" the environment to sustain their production, their management practices have to be in harmony with the environment. It is the strong awareness of the sensitivity of the environment today that is changing agricultural activities to ensure that not only a sustainable environment for agricultural production continues, but that also a safe environment for others is achieved. The challenge is to find the balance so it is not at the total expense of the farmer.

It is not possible for me to address the siting of livestock facilities specifically, without thinking of why are we interested in this in the first place. Are we concerned with farm building siting for the sake of the neighbour? Environment? Farmer? I would like to think that we are working towards protecting the farmers' environment, the natural environment as well as the public's interests. With the right balance of actions, together they are powerful tools for the sustainability of agriculture as well as developing appropriate agricultural planning and practices that ensures a good environment also exists for the general public.

The sustainability of agriculture in our communities does not only depend upon the preservation of the farmland, but also the preservation of our farmers. But the "environment" in which farmers operate in today is becoming continuously subjected to urban pressures that is threatening the very survival of our farmers and therefore our home grown food supply. Apart from relying upon the farmer's strong will to survive to help combat these urban pressures, there is a need for governments' strong commitment and effective policies to protect the farms from dissolution. In addition, there is a need for a better understanding of agriculture by the general public. The public often sees farmland as their green space, their country areas for visiting, but at the same time are often unaware of the support that they can give for the protection of our agriculture. It is timely that I have the opportunity to offer you my presentation today as British Columbia's Provincial government has just introduced a new "Farm Practices Protection"
I would like to refer to principles of this Act in my presentation as it relates to land use planning that includes siting of buildings, to address urban/rural interfaces and conflicts from urban encroachment.

I believe we are all aware of what agriculture faces with urban encroachment. Urban encroachment brings an "attitude" with it that is ready to question the adjacent agricultural activity or farm development. Unfortunately, this "attitude" does not only come from the city interface but is also occurring in the heart of the farmland. This is often the result of new non-farming neighbours moving out of the city to "enjoy the country life". But soon after arriving, the new neighbours are complaining of the "offensive" odours and noises from the normal agricultural practices in the country area. Therefore, although we often attempt to solve our conflicts through farm building siting and restrictive management, I place public awareness programs as a high priority as I do believe that the public can live with, and enjoy, agriculture if they understand it.

To address the conflicts and issues of agriculture as they relate to our Province, I would first like to give some background of agriculture in British Columbia.

British Columbia is a large province (bigger than Washington, Oregon and California combined) but it has only a small amount of productive agricultural land. B.C. consists of over 94 million hectares of land (232 million acres) with the majority of this land base being mountainous. Only 5% of the Province has been recognized as capable for agricultural production and designated under provincial legislation into the Agricultural Land Reserve (ALR). However, the wide variability in the capabilities of this Agricultural Land Reserve results in a very productive agricultural industry that supplies over 60% of the food requirements for the 3 million people of the Province, as well as exports millions of dollars worth of products to countries such as Japan, USA, and England.

Agricultural production in BC is also extremely diverse resulting in the production of over 120 different agricultural commodities and employment of over 210,000 people. Agriculture plays a major role in the Province's economy and this is supported by the fact that total farm capital investment for British Columbia is over $8.5 billion!

Unfortunately, in the limited high intensive agricultural areas of the ALR, such as the Fraser Valley that houses thousands of birds and animals for agricultural production, it is also the home for thousands of B.C.'s human population that is increasing at a "conflicting" pace. At a recent Greater Vancouver Regional District seminar, it was estimated that "in the next 30 years, another 1.2 million people will move into the Lower Mainland. It is this type of situation in the province that has created urban pressures, whether it be such things as competition for the land base, nuisance complaints with respect to farming practices, the occurrence of vandalism including damage and theft of crops, or increased flooding from adjacent urban development.

Cases of conflict are varied but they can stem from government's poor planning, both provincially and locally, inappropriate farm practices close to an urban population or the non-farming population just not fully appreciating normal farming practices involved in food production. Whatever the reason, it still has to be understood that agricultural areas constitute the only work place for the farmers and their families. We must work towards eliminating those conflict situations that are continually eroding the "farmers' environment" and the confidence of the farmer to continue to farm.

I would like to review some of the conflicting factors that can affect the "farmer's environment" and the sustainability of the farmer in our Province as shown in the following diagram.
Some brief discussions of these "conflicting factors" include:

**land prices**: prices increase beyond agricultural value created by competition for alternate uses of farmland (e.g. golf courses, urban development)

**local government planning**: unduly restrictive bylaws, often created in response to non-farm residence complaints, can restrict agricultural growth and create existing farms nonconforming.

**pollution control standards**: environmentally sound practices are required but extreme standards can become too costly to meet.

**labour quality and supply**: lack of labour supply and properly trained help affect production efficiencies and costs.

**input costs vs. returns**: high input costs and low returns and can relate to government policy.

**government policy**: impact of changing government policy e.g. the North American and USA Free Trade Agreements, GATT rulings, monetary policy, provincial and federal support programs and right to farm legislation.

**resource use conflicts**: competition for land use e.g. cattle rangeland vs wildlife and recreational use, wetland expansions.

**urban/rural conflicts**: nuisance complaints and resulting bylaws, vandalism, residential development drainage runoff, etc.

**consumer attitude**: lack of consumer unawareness of how food is produced, therefore not truly financially supportive of the farmer.

**food safety**: public demanding overly restrictive controls on farm management in pesticide and fertilizer use but not willing to pay for it.

**animal welfare**: animal rights groups (different than animal welfare) becoming very influential and demanding costly farm changes and possibly the closing of certain farms.

**environmental influences**: weather influence on crop production and loss e.g. floods, droughts.

As I had mentioned in the start of this presentation, the challenge is achieving the right balance of actions for the sustainability of agriculture that ensures a good environment also exists for the general public. I believe it has been with this in mind that has instigated a variety of actions being taken by the governments and the farming industry of the province. The various actions taken are often strongly dependent upon each other. For example, the siting of the building can be quite irrelevant to a neighbour if bad management of the farm exists or pollution of a common stream occurs.

Actions to date in BC to address this challenge can be considered under the following headings:

- Farmland Protection
- Environmental Protection
- Farmstead Protection
- Farmer Protection
- Urban-rural Conflict Solving

**FARMLAND PROTECTION**

Farmland, including soil, is preserved under the following Acts:

**Agricultural Land Commission Act** - When this Act was assented to by the provincial legislature in April 1973, it created the Provincial Agricultural Land
Agricultural Land Reserves (ALR) throughout British Columbia. The principle objectives of the new legislation were the preservation of agricultural land for farm use and the encouragement of the establishment and maintenance of family farms. With this Act in place, it restricts any change to a non agricultural use or subdivision of land within the ALR unless approved by the Commission.

During the inception of the farmland preservation program, there was early recognition that saving the land alone would not be enough. The farmers who used the land also required attention. The Act was thus only one aspect of the larger overall objective of enhancing agricultural production throughout the province. As a result, other agricultural support programs such as Farm Income Insurance, low interest loans, etc., were initiated to complement the farmland preservation program. These latter support programs have now been mostly eliminated.

Soil Conservation Act - The purpose of this Act is to preserve, maintain and in some cases enhance the quality of the soil within the Agricultural Land Reserve. The Act is designed to prevent the removal of agricultural soil, the deposition of debris such as from construction demolition, control the quality of fill being placed on designated agricultural land and ensure an acceptable level of rehabilitation.

ENVIRONMENTAL PROTECTION

With the realization that our environment is becoming "damaged" from our many activities throughout the Province, the need for change is evident. Farming is one activity that needs to be reviewed to ensure that everyday farm management practices are in harmony with the environment. Perhaps some farm practices that have been used for many years, when evaluated today, may not necessarily be the best for the environment. In harmony with the environment today means in harmony with the public but, at the same time, sort out the acceptable versus excessive demands on agriculture. If the farms are sound manner, we have found that it helps to defend them against unwarranted nuisance complaints, unduly restrictive bylaws and a negative public attitude.

B.C.’s approach in areas of environmental protection from agricultural activities includes the development of the following regulations and programs:

- Agricultural Waste Control Regulation and Code of Agricultural Practice for Waste Management
- Best Agricultural Waste Management Plans
- Canada/ B.C. Soil Conservation Program
- Farm Peer Group Advisory Services

Agricultural Waste Control Regulation and Code - The previous waste management regulation under the Waste Management Act came under question by the Ministry of Environment, Lands and Parks because of the lack of detail and the difficulty in determining the appropriate farming practices required for acceptable agricultural waste management. This regulation was of particular concern because farmers, unlike all other industries, operate without the requirement of a permit to handle their agricultural wastes, but under the assumption that acceptable agricultural practices are occurring.

To attempt to administer these regulation sections without sound standards of acceptable agricultural practices at one's disposal was difficult. It led to a wide number of conflicts when trying to correct a farm pollution situation and the interpretation of the required corrective measures of a "reasonable manner" varied substantially between the farmer and the enforcement officer.

To address this problem, the Ministry of Environment, Lands and Parks and the Ministry of Agriculture, Fisheries and Food formed an Agricultural Waste Committee. Other representation on the Committee included B.C. Federation of Agriculture, Regional Districts and Federal Dept. of Fisheries and Oceans. Other
guests were included when specific topics were discussed and their expertise was needed. The Committee developed an "Agricultural Waste Control Regulation" that still retained the exemption of a permit, supplemented by a "Code of Agricultural Practice for Waste Management". Farmers are required to meet the Code's standards to retain the exemption of a permit.

The purpose of the Code is to

a) support the new proposed waste management regulation by clarifying the kind of agricultural operations on the farm and the acceptable practices in the carrying out of these operations, and

b) assist farmers in reducing the potential of their agricultural operations to pollute air, soil, surface and ground waters, and to recommend agricultural practices for the rational use of land and buildings in relation to the various agricultural operations.

In the development of the regulation and code, individual meetings with the various commodity farm groups throughout the Province were undertaken to discuss the farm environmental issues and to obtain input into the draft. Excellent response was received from the farm community and constructive input made that has resulted in a fairly comprehensive set of standards for the Code that we have all agreed upon. In fact, farmers were already implementing the Code requirements even though it was not passed until April 1992.

The Code consists of various parts that address:

- Storage and Use of Agricultural Waste
- Application and Composting of Agricultural Waste
- Agricultural Emissions
- Storage and Use of Wood Waste
- On Farm Disposal of Mortalities
- Feeding Areas and Access to Water
- Use and Storage of Agricultural Products

Siting requirements within the Code all relate to either watercourses or domestic water supplies and mainly address location of storage (e.g. manure) facilities, field storage of manures, composting facilities and feeding areas for livestock. Setbacks ranged from 30 metres from domestic water supplies (wells) and 15 to 30 metres from water courses.

To complement the new regulation and code, the Ministry of Agriculture, Fisheries and Food, in cooperation with the agricultural industry, is establishing "Environmental Guidelines" for each farm commodity group. These guidelines will describe, in detail, the various management practices and building requirements that farmers must consider to operate in an environmentally sound manner.

**Best Agricultural Waste Management Plans**

These Plans are intended to provide waste management recommendations to farmers that have pollution concerns with such things as:

- livestock manure storage or handling
- dead animal disposal
- livestock feed (silage juices)
- dairy milkhouse waste
- yard runoff
- greenhouse waste water

For the first two years of the Code being introduced, to obtain a Plan, the farmer would contact the local agricultural office and discuss the situation with the District Agriculturist. If the D.A. determines that a Plan is needed, a work request was sent to the Resource Management Branch of the Ministry. An engineering specialist would visit the farm with the farmer and jointly develop the Best Agricultural Waste Management Plan to address the identified or potential problems. A written report was sent to the farmer with specific recommendations for change. All correspondence and discussions were confidential between the parties. This program has since been privatized with plans being completed by consultants. Under certain cases, the Ministry will become involved with plan development.
programs to acquaint farmers with its requirements, assures compliance and responds to concerns and problems. Where an individual, group or government has a concern about environmental practice on a farm, the Council initiates a process, including a farm inspection from "peer" farmers of the particular commodity, to ensure the farm in question is in compliance with the Code. This is the case of the farmer protecting his own environment, as well as the natural environment.

The Cattlemen's program operates also with peer group inspections but does not have a similar Council as the Federation.

FARMSTEAD PROTECTION

The provincial Municipal Act gives local governments the authority to enact and enforce a variety of land use plans and zoning bylaws that affect agricultural operations. However, all municipal planning within the Agricultural Land Reserve is subject to the Agricultural Land Commission Act. Most local governments' legislation relating to agriculture are zoning bylaws that can zone particular areas for agriculture within regions or districts, along with establishing such things as specific setbacks for the siting of farm buildings, possibly density of operation, size of manure facility.

A major concern for agriculture has been the severe action that local governments often take in response to nuisance complaints. Even though complaints may have been against one particular farm, justified or not, the bylaws created too often penalize the whole farm commodity group represented by that particular farm. As always in these situations, there are more neighbouring residents complaining against a small minority of farmers that can often result in the local politician catering to the influence of "the greater number of the electorate".

Changes to the Municipal Act were made in late 1985 by adding an intensive agriculture section (Section 977), to attempt to address the problem of the continual development of inconsistent and
often unduly restrictive bylaws for agriculture throughout the Province. Unfortunately, the legislation as it was implemented was not as expected and therefore has been unable to be used.

Up until the new Bill 22: Farm Practices Protection (Right to Farm) Act was introduced in May of this year, we worked with local governments to help establish "fair" bylaws and in the process establish some general standards for agricultural bylaws and plans. We have found that working with local governments on a regular basis, and not only when the bylaw is driven by complaints, can result in good planning that in the long run benefits the farmer and neighbours and as well receives the support of local governments if any controversy arises at a later date. Unfortunately, not all local governments have been as receptive and some still continue to create unduly restrictive bylaws for agriculture.

In the Province, conflicts vary and do not always arise on the boundaries between the farmland and non agricultural land users. However, local governments have often insisted on the development of buffers between the urban/rural users whether there was a problem or not. Unfortunately it always seems the buffer planned is to be at the expense of the farmers but for the benefit of the urban neighbours. One recent Fraser Valley municipality investigated the "attitudes" of their city residents that were adjacent to farmland. A major response from the residents as quoted in the report was that they "loved" living there, next to farmland. However, when the adjoining farmer was canvassed, major concerns were expressed relating to such things as vandalism of equipment, fence damage, and crop theft.

Some buffers have proven to be beneficial to the farmer for protection from public intrusion. Major highways, rivers or drainage ditches usually act as excellent buffers. Buffers on the urban side of the boundary can also be created by establishing zones that allow developments less "sensitive" to farming activities. Examples being commercial and industrial zones, golf courses and parks, or even the playground of a school placed at the boundary rather than the actual school building.

For the public’s benefit, we have recognized that greater setbacks of certain farm buildings from the urban/rural boundaries also help to reduce or prevent any conflicts. Unfortunately, it often seems to depend upon how educated the community is with agricultural production and the strength of agriculture in their community that helps determine the size of the setback. This of course makes it difficult to make consistent setbacks for farm buildings for the Province.

The introduction of Bill 22, I believe, now offers to lead the way in Canada for planning fairly for agriculture. The Bill addresses two major areas of concern. One is the "Right to Farm" that will protect the farmer against nuisance suits and court injunctions if the farm operation is being "conducted in accordance with normal farm practices". A Farm Practices Protection Board will also be established to hear complaints and rule on cases. This part is very similar to the Ontario legislation.

The second area addressed is planning for agriculture under: Consequential Amendments and Commencement. It offers for the first time in the province, a legislative requirement for the Minister of Agriculture, Fisheries and Food to approve all bylaws that affect agriculture in the Agricultural Land Reserve. In addition, it allows for the Minister to "establish, publish and distribute standards in relation to farming areas for the guidance of local governments in the preparation of rural land use bylaws, zoning bylaws and bylaws" under a specific division of the Municipal Act.

The Bill also introduces a new type of bylaw called, "farm bylaws" that a local government may create, in relation to farming areas (i.e. areas in the ALR and aquaculture areas to be licensed under the Fisheries Act).
These bylaws can address:

- conduct of farm operations as part of a farm business
- respecting siting and types of buildings, structures, facilities, machinery and equipment that are prerequisite to conducting farm operations specified by the local government and that must be utilized by farmers conducting the specified farm operation,
- respecting the siting of stored materials, waste facilities and stationary equipment, and
- prohibiting specified farm operations

The bylaw may also prescribe differently for different

- sizes or types of farms
- types of farm operations
- site conditions
- uses of adjoining land, or
- areas

These standards can also be directly incorporated into a regular zoning bylaw and not necessarily in a farm bylaw type but will still require the Minister's approval.

In the process of drafting this legislation, myself and Barry Smith (Planner, Agricultural Land Commission), consulted throughout the province directly with several Mayors and Councillors and Chairs of Regional Boards and Directors to introduce the concept of the legislation. In all meetings, the local governments were supportive. An area that they like particularly was the flexibility being built in allowing for "tailor" made bylaws relevant to their areas and situations.

Once the standards for the bylaws have been established (ongoing process at present), the Act will allow the Minister of Agriculture, Fisheries and Food to require local governments to review their existing bylaws and if necessary change them within 3 years to "achieve consistency" with standards established by the Minister.

Finally, this section of the Act supplies the necessary legislation for local governments to not approve an urban development adjacent to a farming area unless adequate "screening, landscaping, fencing and siting of buildings or structures, in order to provide for the buffering or separation of development from farming on adjoining or reasonably adjacent land.

So, what will this mean to setbacks for farm buildings? When the new Act is passed, there will be a process of establishing the various standards for bylaws in consultation with the local governments and agricultural industry. In the past, basic setbacks from farm property lines for farm structures within the farming areas have been encouraged to be 30 metres from side, rear and front lot lines, and up to 60 to 90 metres for swine, feedlots and fur bearing animal structures from the same lot lines. We see these same type of setbacks being established in the new standards.

The area of flexibility in the standards for bylaws are expected to occur at the various urban/rural interfaces. We have previously implemented, in some municipalities and regional districts, greater setbacks for farm buildings from adjacent boundaries where there is a high "sensitivity" to farm complaints, e.g. at the city boundary. This type of setback has ranged from 200 to 400 metres. In return for the agricultural communities' support for these greater setbacks, mainly at their expense, we made substantial changes to the non-conforming section of the Municipal Act (Section 970) . This Section protects the farms made nonconforming by new bylaws. Whereas other nonconforming industries that have discontinued their use for more than 6 months are required to meet the new bylaw requirements to start up again, agriculture is given more flexibility.

A non-conforming farm not operating for more than 6 months, would not have to meet the new bylaw requirements if it's use was discontinued due to " result of normal seasonal or agricultural
practices, including

- seasonal, market or production cycles,
- the control of disease or pests, or
- the repair, replacement or installation of equipment to meet standards for the health or safety of people or animals.

The non-conforming farm can be rented or sold for the existing farm use without having to meet the new bylaws. If the farm is to be expanded then the new expansion must meet the new bylaw.

Along with this new Act comes the ability to prohibit certain agricultural land uses within the Agricultural Land Reserve in areas of potential conflict, again usually adjacent to a residential area. For example, if agreement is reached between the local government, agricultural industry, MAFF and the Land Commission, then perhaps uses such as swine or mink farms, high odour potentials, will be prohibited within several hundred metres of the interface. However, the importance of reviewing every interface in the various regions is to ensure that the land that the prohibition is being applied to has the potential to be used for some other agricultural use. This is of particular concern where the soil is not of the better class and therefore already has limited uses. Too much restriction will only result in the land owner at the Land Commission’s door accusing us of eliminating the various options available for agriculture and requesting it to be removed from the ALR for residential purposes. Obviously, working against the whole intention of the planning process intended to encourage and protect agriculture. Over the next few months, standards will be developed and shared with the other provinces when available.

**FARMER PROTECTION**

Although there was a so-called "right to farm" in BC before this new Act, it gave little protection for the farmer. The new Act, using Ontario’s as a base, offers much more protection along with a new Farm Practices Protection Board. Often, "right to farm " legislation takes on an attitude of the non farming community as allowing the farmers to “do as they like now”. As all of you ever involved in “right to farm " legislation know, often it can result in more restrictions on the farmer to operate correctly all the time. I question if that is a "normal" demand. However, the public is protected against inappropriate farm practices. The development of a new regulation and code of agricultural practice for the Waste Management Act (discussed under the Environmental Protection section) under the Ministry of Environment, Lands and Parks was enacted in April 1992 sets the required standards for farms to operate in an environmentally sound manner. This legislation is also expected to help in establishing what are “normal farm practices.” It is believed that the waste management regulation and code will help separate between legitimate complaints of pollution and the often unwarranted nuisance complaints against farms. If the farmer is complying with the code, therefore not polluting, then defense against an unwarranted complaint, such as the smell of manure when applied as a fertilizer without pollution, will be easier, under the new Farm Practices Protection Act.

**URBAN - RURAL CONFLICT SOLVING**

The Greenzone program of our Ministry of Agriculture, Fisheries and Food that I am responsible for addresses urban/rural conflicts, local government planning for agriculture, right to farm legislation and environmental standards for agriculture. Experience from this Greenzone program in B.C. has revealed that there are several conditions necessary, usually all dependent on each other, in order to solve the problems derived from urban pressures. Providing you can achieve these conditions, solving urban-rural problems can be easier and also aid in the sustainability of agriculture. This
CONCLUDING REMARKS

Provincial and local government planning must at first be willing to designate areas for agriculture with the intention of keeping it in agriculture. With this commitment, local government bylaws can be established to complement the preservation of the agricultural land base, the farmer, as well as address the urban concerns fairly.

In order to protect farmers from unwarranted nuisance complaints and unduly restrictive bylaws, good, clean farm practices must be established and enforced. Protection of polluting farmers must not occur as it will result in the loss of respect for the whole farming community. However, in support of those farmers operating in a sound legal manner, right to farm legislation should be considered to protect the farmers from unwarranted nuisance suits.

There is definitely a necessity to educate the public more about farming. When I get called out to a local government Council and public meeting to discuss a restrictive bylaw for agriculture, often the result of neighbours' complaints, I always request the opportunity to show a few slides. It never seems to fail that when the public sees slides of food on the table and then the methods used in production of that food, their restrictive demands on agriculture mellows. It seems that for the first time they realize where their food comes from, maybe from right next door! For those of us in agriculture, we must take some responsibility of this unawareness of the public with agriculture.

We must increase our involvement in educating the public of the importance of agriculture in the community, the significance of buying home grown products and the importance of supporting necessary farm legislation and programs. Perhaps our food packaging should not only talk of it's nutritional value but should inform the consumer that by purchasing this product you are helping to save our agriculture. Make the consumer proud of participating in preserving our agriculture. Perhaps we should have colourful photos and posters of the farms where the particular product comes from throughout the stores.

Finally, there is a need for agricultural education in our schools. Not to create "aggie" courses because students won't elect to take them anyway, but to incorporate a complete awareness of agriculture and it's affect in the lives of the students. An "Agriculture in the Classroom Foundation" has been formed in B.C. by farmers, agricultural industries, teachers and Ministry staff to encourage the awareness of agriculture within the schools. The Foundation has recently completed a strategic plan for the province that will be implemented hopefully over the next two years.

The challenge of preserving agriculture and the farmer in our communities and countries, grows with each passing year. As the human population increases, as the land use needs for housing, recreation, business and servicing requirements grow, so too does the challenge to maintain our agricultural land base, retain our farmers and food supply.

Accommodating these various land uses in a manner that respects our limited foodland for the long term is a challenge that will only be met through the continued joint action by all levels of government and the support of the public in general. There must exist a stable environment within which the agricultural industry can operate.
of experiences in the world that we must draw upon. Hopefully, this will help us to establish some sensible planning for our communities and help the public understand agriculture's needs to continue to produce our food into the future.

In conclusion, I believe that the setback of various farm buildings, other than to prevent water pollution, is mainly for the purpose of a neighbour. If this is the case, sometimes it is difficult to take a setback required in Saskatchewan of perhaps a half or one mile from a town or city and try to apply it to the Fraser Valley of BC. We may be existing very well with 100 feet! So, I believe that the attitude, and I suppose space available can determine acceptable setback requirements. However, I caution making policies that seem to only concentrate on one aspect of many issues such as siting of farm buildings for the convenience of neighbours as if putting a blame on the farmer for being there. We can't blame farmers for farming in a farming area! That's what we want them to do!
ONTARIO APPROACH TO SITING LIVESTOCK AND POULTRY OPERATIONS

Mike Toombs
Ontario Min. of Agric. Food and Rural Affairs
Newmarket, Ontario

Currently Rural/Urban Interface Specialist
Dealing with issues including the Agriculture Code of Practice, min. separation distances, Certificate of Compliance program
Secretary for the Farm Practices Protection Board
Past projects include Land Stewardship Practices Manual, Agricultural Pollution Control Manual, and Care and Maintenance of Rural Septic Systems

INTRODUCTION

Ontario has had a long history in the siting of livestock and poultry facilities. In 25 years the Agricultural Code of Practice has progressed from a guideline which only located livestock facilities to a provincial policy that sites all new development, land uses, and new or expanding livestock facilities in agricultural Ontario. The application of the Minimum Distance Separation formulae has proven to be an effective means of odour conflict prevention.

BACKGROUND

The need to control the siting of livestock and poultry facilities has increased in a direct relationship with the rural population trends in Ontario.

In Ontario in 1930, during the Great Depression, farmers represented approximately 60%, or 0.8 million people of the total rural population of 1.35 million. Those who did not directly work on farms often had agriculture-related jobs. In the 1950’s, with farm mechanization, and improved production techniques and specialization, the rural farm population started to decline. By 1991, the total rural population was 1.83 million, which is a 35% increase from 1931. By comparison, non-farm rural population increased over 290% during the same time period. Farmers represent only about 12% of the rural population of approximately 0.22 million people. From these statistics it is clear that while the rural population is increasing, the farm population is actually decreasing. Farmers are increasingly surrounded by non-farm neighbours with little understanding of agriculture. This trend is expected to continue.

In the early 1970’s, the livestock industry in Ontario became concerned about the odours and water pollution potential associated with the handling, storage and utilization of livestock and poultry manures. In March 1970, a suggested Code of Practice was prepared to provide guidelines for livestock producers in meeting these problems. Revisions and changes were
made in a subsequent edition published in 1973. While the Code contained a framework for the establishment and expansion of livestock enterprises, it provided little protection from encroachment by other uses of land. The Agricultural Code of Practice, 1976, incorporated a number of changes and provided a two-way approach to the maintenance of a strong livestock industry.

The 1976 Agricultural Code of Practice provided a means to objectively calculate adequate buffers or separation distances between farm and non-farm uses and to provide guidelines for good farm practices. Separation distances varied according to type of livestock, size of farm operation, the manure system and the neighbouring land use.

In agricultural Ontario, the Agricultural Code of Practice was embodied in most municipal official plans and many comprehensive zoning bylaws. Some townships required compliance with the separation distances to issue a building permit for farm buildings.

This has become an accepted and fundamental tool of land use planning in rural Ontario. Because of the Agricultural Code of Practice, agriculture was partially exempted from the Environmental Protection Act.

Since 1976, Ontario Ministry of Agriculture, Food and Rural Affairs agricultural engineers have done over 12,000 calculations on the siting of farm buildings. The Land Use Planning Branch considers separation distances on every application reviewed, and completed between 5,000 and 15,000 calculations per year. The differential of these numbers is a clear reflection of the population trends illustrated in Figure 1.

In 1990, farm building construction was brought under the Ontario Building Code. It became necessary to obtain a building permit for all agricultural construction projects in Ontario.

REGULATORY FRAMEWORK

The 1983 Planning Act was significantly amended by Bill 163 which was proclaimed in March 1995. The amendments to Bill 163 were the Ontario government's response to recommendations from the (Sewell) Commission on Planning and Development Reform in Ontario.

Under Bill 163, land use decisions will have to "be consistent with" provincial policies. This means that Official Plans will also have to be consistent with provincial policies.

Provincial policies are set out in the Comprehensive Set of Policy Statements. The goal of Policy D, Agricultural Land Policies, is "to protect prime agricultural areas for long-term agricultural use". Policy D5 states "New development and land uses, and new or expanding livestock facilities will comply with the Minimum Distance Separation formulae." Therefore, policies which require compliance with the Minimum Distance Separation (MDS) formulae must be incorporated into municipal
planning documents.

In conjunction with Bill 163, the Agricultural Code of Practice was revised to reflect changes in farm practices since 1976.

THE REVISED AGRICULTURAL CODE OF PRACTICE

Staff of the ministry’s Land Use Planning Branch and the Agricultural Engineers arranged a consultation with all of the provincial livestock commodity groups, the Ontario Federation of Agriculture, the Rural Ontario Municipal Association, and county and regional Planning Directors. An information meeting was held to explain the proposed changes. Written comments were requested, and received. Most of the suggestions were incorporated into the document. Individual meetings were held with groups on a request basis.

A simpler, easier-to-use format was adopted, switching to three stand-alone companion documents, each aimed at specific user groups:

! Minimum Distance Separation I (MDS I) is used by municipalities, Ministry of Environment and Energy, and planners to site new non-farm development adjacent to livestock facilities.

! Minimum Distance Separation II (MDS II) is used by Ontario Ministry of Agriculture, Food and Rural Affairs engineers and municipalities to site new or expanding livestock facilities.

! The Guide to Agricultural Land Use will be used by farmers, rural residents, municipal councillors and land use planners as a source of general information on farm practices and as a source of reference to more detailed information. The Guide is not provincial policy.

The basic concept and distances developed in 1976 have been maintained. The following revisions were made:

! Livestock types have been added and expanded; ducks, goats, fox, ostrich and emu were added, and swine and poultry types were expanded, totalling 34 types from in 1976.

! Distances for swine were slightly increased. MDS now includes three site swine production systems.

! Distances for horses slightly decreased.

! Distances for very large farms (over 150 Livestock Units) have been increased by up to 16% at 300 Livestock Units.

! Manure storage systems have been updated to meet current recommendations.

! MDS formulae were converted to the metric system.

! MDS I now considers the location and type of manure storage.

! Livestock Units replaced Animal Units. Livestock Units are based on barn capacity, not yearly production. A Livestock Unit is defined as equivalent values for various types of animals, including poultry, based on manure production and production cycles.

! Ease of calculation will enable users to assess proposals with more confidence.

! Active farms abutting urban areas will be better protected from encroachment.

Increases in distances arose because of a complaint history for larger farms or changes in production systems. As in the 1976 Agricultural Code of Practice, the MDS formulae are based on the odour potential of a well-managed livestock operation. Included in the calculations is a factor to allow for reasonable future expansion of the livestock facility.
The following factors are the basis for a MDS calculation:
1. Type of Livestock and Housing Factor A
2. Number of Livestock Factor B
3. Degree of Change Factor C
4. Manure System Factor D
5. Manure Storage
6. Type of encroachment or neighbouring land use

MDS I determines the buffer distance from a barn and/or manure storage to a proposed non-agricultural land use. First, the total number of Livestock Units must be determined, then through look-up tables using the animal group and proposed type of land use change, the building base distance is determined. A second look-up table uses the barn distance to determine the manure storage distance. The proposal must meet both distances from all livestock facilities in the area to be approved.

For MDS II, Factors A through D are multiplied together to get a building base distance. Then, using a look-up table and the building base distance, a manure storage base distance is selected. The two base distances are then applied to the various factors for neighbouring land uses to determine separation distances from the proposed building and/or manure storage to the neighbouring land use.

Table 1 contains MDS II sample distances for a new facility, assuming vacant farmland with no livestock present and a liquid manure handling system. Livestock numbers are based on the housing capacity at any one time. Distances are measured from the closest part of the barn to the closest part of the neighbouring land use or boundary. Distances for expansions of existing operations totalling the same amount of livestock numbers would be smaller.

IMPLEMENTATION

The implementation of MDS formulae will be gradually adopted as municipalities revise their official plans and comprehensive zoning bylaws. Currently, implementation of the MDS formulae is dependent on what is in a municipal Official Plan and Comprehensive Zoning Bylaw. As Official Plans are updated, MDS I will be implemented through a policy in the Official Plan for all Planning Act applications that are proposing a change in land use. MDS II will be implemented through the Comprehensive Zoning Bylaw, as there is no land use change with the issuance of a building permit.

In general, the MDS formulae will be implemented through a land use change as in the case of MDS I, or through a building permit application in the case of MDS II. As a land use change is proposed, the municipality applies the MDS I formula to ensure that a livestock facility is not encroached upon.

For siting new or expanding livestock facilities, the MDS II formula is applied. At the time of building permit application, the farmer completes a data sheet that is available at both the municipal office and the local OMAFRA office. The building department can either complete the calculations or request the local OMAFRA engineer to provide the calculations. The farmer must demonstrate that the minimum distance separation requirements can be met before a building permit can be issued.

If the distance requirements cannot be met, the farmer can either relocate the proposed facility on the farm, or apply for a minor variance. Decisions on minor variance applications are made by the local Committee of Adjustment. Municipal officials must consult with OMAFRA staff when considering a minor variance to MDS II distances. In specific circumstances, conditions that meet the intent, if not the precise distance of MDS II, or mitigate environmental impacts will be considered.

A series of workshops were offered across the province to municipal staff and consultants to ease the implementation of MDS formulae. Ministry staff are also providing individual training on implementation of MDS formulae on request.
SUMMARY

With the increase of rural non-farm residents, a mechanism to prevent odour conflicts is required now more than ever. The revision of the Planning Act makes implementation of the MDS formulae mandatory and provides the regulatory framework for that mechanism. Revision of the MDS formulae should build on the earlier successes in preventing odour conflicts and provide an effective tool to prevent future conflicts.

Table 1 - Minimum distance separation ii sample distances in metres

<table>
<thead>
<tr>
<th>Proposed Agricultural Operation</th>
<th>Nearest Neighbour's Dwelling</th>
<th>Areas Zoned or Designated Agriculturally Related Commercial Use or Passive Recreational or Industrial</th>
<th>Residential Subdivision, Urban Area, Areas Zoned or Designated Institutional, Active Recreational or Commercial</th>
<th>Nearest Side or Rear Lot Line</th>
<th>Nearest Road Allowance (Side or Front Lot Line)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 Sows Farrowing Weaning at 14 Days</td>
<td>290 (297)$^1$</td>
<td>290</td>
<td>580</td>
<td>58</td>
<td>73</td>
</tr>
<tr>
<td>1000 Head Nurse Barn</td>
<td>238</td>
<td>238</td>
<td>476</td>
<td>48</td>
<td>60</td>
</tr>
<tr>
<td>1000 Head Finishing Barn</td>
<td>405 (399)$^1$</td>
<td>405</td>
<td>810</td>
<td>81</td>
<td>101</td>
</tr>
<tr>
<td>100 Milking Cows Free Stall</td>
<td>228 (222)$^1$</td>
<td>228</td>
<td>456</td>
<td>46</td>
<td>57</td>
</tr>
<tr>
<td>52,000 Chicken Broilers</td>
<td>234 (200)$^1$</td>
<td>234</td>
<td>468</td>
<td>47</td>
<td>57</td>
</tr>
</tbody>
</table>

$^1$ 1976 MDS II Distances
REFERENCES


Ontario Ministry of Agriculture, Food and Rural Affairs and Ministry of Environment and Energy "Minimum Distance Separation II (MDS II)". Toronto, Queen's Printer. 1995.


PERSPECTIVES ET APPROCHE DU QUÉBEC POUR FAIRE FACE À LA PROBLÉMATIQUE ENVIRONNEMENTALE ASSOCIÉE À L'INTENSIFICATION ET LA CONCENTRATION DES ÉLEVAGES

Michel Patoine
Min. de l'environnement et de la faune
Ste.Foy, Québec

! 1988-1992: Expertise technique relative à l'application de la réglementation et du Programme d'aide à l'amélioration de la gestion des fumiers pour le ministère de l'Environnement du Québec

! 1995-1995: Élaboration de la réglementation future sur la réduction de la pollution d'origine agricole et expertise technique sur la réglementation en vigueur pour les établissements de production animale

INTRODUCTION

Les changements dans la production agricole au cours des dernières décennies, au Québec comme dans d'autres sociétés industrialisées, se sont produits essentiellement sur la base des résultats économiques et de production. Ces changements ont entraîné une dégradation de la qualité de l'environnement et un gaspillage de ressources, et ont fait ressortir la fragilité du milieu naturel dont on croyait la capacité de réception illimitée.

Depuis le début des années 1980, le gouvernement du Québec s’est doté d’outils pour prévenir la pollution d’origine agricole résultant notamment de l'intensification et de la concentration des élevages porcins, de volaille et de bovins laitiers et de boucherie. L'approche retenue par le Québec est ici discutée ainsi que les perspectives d'avenir.


PROBLÉMATIQUE ENVIRONNEMENTALE ÉVOLUTION DE L'AGRICULTURE AU QUÉBEC

Au cours des 40 dernières années, l’agriculture au Québec a connu des changements majeurs principalement attribuables aux objectifs de haute productivité poursuivis, qui se sont traduits par la spécialisation, l'intensification et la concentration des productions animales et végétales.

Au cours de cette période, le nombre de fermes est passé de 135 000 à 40 000, dont environ 30 000 spécialisées en production.
animale. Par contre, le nombre total de porcs, de volailles et de bovins de boucherie a augmenté d'un peu plus du double, et le cheptel laitier a légèrement diminué (Figure 1). Ces changements ont entraîné une augmentation de plus de 50 fois de la taille moyenne des élevages de porc et de volailles, et une concentration de ces élevages dans certaines régions. Le nombre de bovins laitiers et de boucherie par ferme a également augmenté, mais à un niveau moindre (Tableau 1). La quantité totale de fumier produit est en outre demeurée constante, mais sa production s’est concentrée dans certains secteurs.

Durant la même période, les superficies totales cultivées passaient de 2,3 à 1,6 millions d'hectares, alors que les superficies occupées par le maïs augmentaient de dix fois pour atteindre près de 330 000 hectares et les quantités d'engrais minéraux utilisés augmentaient de plus que trois fois (Tableau 1).

Plus de 3000 fermes, principalement spécialisées dans l'élevage porcin et avicole, ne disposent pas des superficies cultivées suffisantes pour recycler adéquatement les lisiers qui y sont produits. Le nombre d'animaux dont les déjections ne peuvent être épandues sur la ferme d'élevage correspond au quart du cheptel animal québécois et génère un volume de surplus des déjections animales à gérer évalué à plus de 4 millions de mètres cubes annuellement. Environ 60 de ces producteurs en surplus sont concentrés dans les bassins des rivières Yamaska, L'Assomption, Chaudière, Saint-François et Etchemin.

**SOURCES ET CAUSES DE LA CONTAMINATION**

L'entreposage inadéquat des déjections animales à la ferme constitue une source non négligeable de contamination consécutive à l'élevage d'animaux, en particulier lorsqu'un mode de gestion liquide est retenu. Ce problème est d'autant plus important que le mode de gestion des déjections a tendance à passer d'une forme solide vers une forme liquide. L'augmentation du volume à gérer, le manque d'absorbants à la ferme ou à proximité et la mécanisation du travail ont déjà amené les élevages de porcs et de pondeuses à privilégier une gestion sous forme liquide. Cette même pratique s'implante graduellement dans l'élevage de bovins. Les impacts environnementaux inhérents à ce mode de gestion sont plus grands quant à la contamination des eaux et au dégagement d'odeur.

L’épandage des déjections animales à des doses excessives ou à des périodes improprées constitue une source majeure de contamination, en particulier dans les zones où sont situées les fermes en surplus. Souvent combiné à un ajout d'engrais minéraux, l'épandage des déjections à des doses excessives ou à des périodes où les plantes ne sont plus en mesure de retenir les éléments fertilisants, comme par exemple après la récolte du maïs à l'automne, entraîne une migration de l'azote et du phosphore qu'ils contiennent dans les cours d'eau ou les nappes souterraines et les contaminent. Des matières en suspension migrent également vers les cours d'eau. D'autres constituants des déjections animales comme les pathogènes sont perdus vers les eaux de surface ou souterraines et dans l'air.
Une étude portant sur dix des principaux tributaires du fleuve Saint-Laurent (Direction de l'assainissement agricole, 1988) estime les rejets aux cours d'eau d'azote et de phosphore provenant des activités agricoles à 48 000 et 16 400 tonnes annuellement. L'étude montre de plus que les pertes d'azote peuvent être attribuées par ordre décroissant d'importance à l'épandage d'abord puis à l'entreposage et à l'érosion, alors que pour le phosphore, l'érosion vient au premier plan, suivi par l'entreposage et l'épandage.

Par ailleurs, la relation entre la densité animale et la concentration en azote mesurée dans les cours d'eau semble assez directe, tel que le démontre la Figure 2 pour certains tributaires des basses terres du Saint-Laurent en milieu agricole.

ATTEINTES À L'ENVIRONNEMENT

Les atteintes à l'environnement, en milieu agricole, portent à la fois sur l'eau, le sol et l'air où la pollution peut être de nature organique ou inorganique.

De par leur augmentation de la densité animale, la croissance de la présence de l'azote ammoniacal est observée dans les eaux de surface, en milieu agricole. Aussi, on note l'apport de matières en suspension et de pathogènes dans plusieurs rivières. Notamment, le rapport sur l'évolution de la qualité des eaux de la rivière Yamaska (Primeau et al., 1990) montre que la qualité globale de la rivière a peu progressé entre 1975 et 1988 même si l'assainissement des milieux urbain et industriel est presque totalement réalisé. Bien plus, la teneur en azote, élément identifié notamment aux déjections animales et aux engrais minéraux, a continué d'augmenter. Dans le cas de la rivière Chaudière, la détérioration de l'eau des secteurs agricoles ne s'est pas accentuée entre 1978 et 1986 (Simoneau et al., 1992), alors qu'une amélioration a été notée entre 1976 et 1987 pour la rivière L'Assomption (Simoneau et al., 1990). La qualité de l'eau de ces rivières demeure toutefois insuffisante dans les secteurs supportant une agriculture intensive pour permettre le plein usage de l'eau.

Le dépassement quasi continu du critère de qualité de l'eau pour le phosphore dans les rivières des principaux bassins agricoles (Etchemin, Chaudière, Saint-François, Yamaska, Richelieu, L'Assomption, etc.) est également préoccupant (Tableau 2). L'apport massif de déjections animales sur les sols, souvent accompagné d'apport d'engrais minéraux, en plus d'augmenter les pertes annuelles, a provoqué une accumulation indue de phosphore dans les sols situés dans les bassins avec une agriculture intensive, et constitue un risque additionnel pour l'eutrophisation des lacs et des cours d'eau. L'inventaire des problèmes de dégradation des sols agricoles du Québec (Tabi et al., 1990) indique que le phénomène de surfertilisation par le phosphore ou le potassium touche environ 20 % des sols en culture au Québec, dont plus de 60 % des superficies sous monoculture, celles-ci étant surtout situées dans la partie méridionale du Québec (Tableau 3).

La pollution de l'eau atteint aussi les nappes souterraines où on observe une concentration de plus en plus forte d'azote sous forme de nitrates. Des études menées par le ministère de l'Environnement et de la Faune (MEF)
démontrent que ce problème se manifeste déjà dans la région de Portneuf où il peut être attribuable aux engrais minéraux notamment dans les secteurs où la culture de la pomme de terre est importante (Paradis et al., 1991), ainsi que dans la Beauce où les déjections animales seraient davantage en cause. Le problème risque d'être plus répandu, étant donné le peu d'études effectuées sur le sujet. Les problèmes reliés aux odeurs sont plus accentués au cours des mois d'été dans les zones de grande concentration d'élevage. Les activités d'épandage ainsi que l'éloignement insuffisant des installations d'élevage par rapport aux habitations sont problématiques, en particulier pour les élevages avec une gestion sur fumier liquide.

PREMIÈRE APPROCHE COERCITIVE DE LUTTE CONTRE LA POLLUTION PAR LES ÉLEVAGES

MOYENS RETENUS

L'adoption en 1972 de la Loi sur la qualité de l'environnement (gouvernement du Québec, 1972) soumettait les projets suspects d'émettre des contaminants à l'obtention d'un certificat d'autorisation. Cette législation donnait un premier moyen d'intervention vis-à-vis la protection de l'eau, de l'air et du sol contre la pollution d'origine agricole. Elle a de plus servi d'assise légale à deux règlements touchant les élevages. Des ressources ont également été consacrées à l'aspect environnemental de la gestion des établissements de production animale.

Réglementation sur l'évaluation environnementale - Règlement sur l'évaluation et l'examen des impacts sur l'environnement (gouvernement du Québec, 1981 b) prévoit que les projets de construction ou d'agrandissement de bâtiments des exploitations de forte taille, soit à partir de 600 unités animales sur fumier liquide ou de 1000 unités animales sur fumier solide, soient soumis à la procédure d'évaluation et d'examen des impacts sur l'environnement avant d'être autorisés.

Cette procédure prévoit notamment que la demande de certificat d'autorisation doit comprendre une étude d'impact sur l'environnement conforme à la directive rendue par le ministre, et que le dossier doit être mis à la disposition du public pour consultation. Une audience publique relative au projet peut être tenue sur demande.

Réglementation sur la protection des eaux - r faire face à la nouvelle problématique de pollution des eaux consécutive à l'intensification des élevages, le gouvernement du Québec a adopté en 1981 le Règlement sur la prévention de la pollution des eaux par les établissements de production animale (gouvernement du Québec, 1981 a).

Ce règlement précise les types de projets d'élevage visés par l'obligation d'un certificat d'autorisation. Il fixe également des normes relatives à l'implantation des bâtiments d'élevage, cours d'exercice et lieux d'entreposage, à l'exploitation de ces installations et à la gestion des fumiers.

Pour apporter une solution à la trop forte concentration d'élevages et aux surplus de fumiers, l'augmentation des cheptels a été limitée jusqu'en 1984 dans les bassins des rivières les plus contaminées, soit L'Assomption, Chaudière et Yamaska, puis depuis 1987 dans le bassin de la rivière L'Assomption. De plus, à partir de 1984, l'implantation ou l'expansion de tous les élevages sur fumier liquide est interdit dans les municipalités où les superficies d'épandage sont insuffisantes, sauf pour les exploitations étant elles-mêmes propriétaires des terres requises pour l'épandage des fumiers.

Des normes d'éloignement des installations d'élevage par rapport aux eaux de surface et prises d'eau potable s'appliquent également à tous les projets. Ces normes varient de 30 à 300 mètres selon la nature et l'utilisation du
point d'eau et sont plus sévères dans le cas des nouveaux établissements que pour les projets d'expansion d'établissements existants.

Les normes relatives à l'obligation d'entreposage étanche d'une capacité d'au moins 200 jours visent tous les élevages avec une gestion sur fumier liquide ainsi que les élevages sur fumier solide de plus grande taille ou situés plus près d'un lac, d'un cours d'eau ou d'un fossé que les distances prévues. Toutefois, les installations des élevages sur fumier solide situées à l'extérieur des municipalités visées en 1981 par le volet urbain du Programme d'assainissement des eaux, et n'ayant réalisé aucune expansion de cheptel depuis le 10 juin 1981, ne sont pas visées par ces normes. Également, le fumier solide d'un élevage sur litière ou d'un établissement abritant moins de 50 unités animales, dont pas plus que 5 unités animales porcines, peut être amassé dans un champ cultivé en respectant les conditions d'aménagement prévues.

L'épandage des fumiers doit être réalisé sans dépasser la quantité maximale annuelle spécifiée. Cette limitation est établie sur la base de l'azote provenant des fumiers, et varie selon les cultures. Pour la culture du maïs et des prairies, par exemple, la limitation est de 170 et 110 kg d'azote par hectare respectivement, ce qui équivaut à 0,24 et 0,36 hectare par unité animale.

L'épandage des fumiers est de plus interdit sur un sol gelé ou enneigé ainsi qu'à proximité de l'eau. Un éloignement minimum de 30 mètres ou de 5 mètres est prévu selon la nature ou l'usage du point d'eau de surface ou souterraine.

Un registre d'épandage et des ententes écrites d'épandage sont requis lorsque les fumiers sont épandus ailleurs que sur les terres appartenant à l'exploitation produisant ces fumiers.

Les normes relatives à l'entreposage des fumiers sont complétées par une directive ministérielle (MENVIQ, 1984) qui visait à l'origine les structures en sol pour s'élargir par la suite aux ouvrages en béton.


Ressources consacrées à l'aspect environnemental de la gestion des établissements de production animale - Le total des ressources consacrées à l'aspect environnemental de la gestion des établissements de production animale entre 1980 et 1987 représente un peu plus de 23 millions de dollars.

En support aux dispositions réglementaires, le gouvernement a investi près de huit (8) millions de dollars dans un programme de réduction volontaire de la production porcine dans le bassin de la rivière L'Assomption.

L'assistance financière a porté également sur la construction des structures d'entreposage. Une partie importante des ressources a également été consacrée à la gestion du règlement, aux inventaires agricoles, aux interventions d'assainissement et à la recherche de développement (Tableau 4). Un projet d'usine pilote pour le traitement des lisiers de porc constitue la principale réalisation de ce dernier volet. Il a permis de démontrer la faisabilité de cette technique, à un coût de l'ordre de 10 $ du mètre cube, et de fournir une alternative au transport à longue distance (Vallée et al., 1989). La distance de transport, à partir de laquelle le
traitement du lisier de porc serait rentable, était dans l'ordre de 10 kilomètres.


Cette étude indique que les interventions, davantage axées sur l'entreposage à partir de 1980, ont permis d'apporter des correctifs sur près de 1500 établissements avec une gestion sur fumier liquide.

Elle précise cependant que les améliorations apportées à la gestion des fumiers ont été insuffisantes pour permettre une récupération sécuritaire des usages des cours d'eau dans les bassins avec une densité animale élevée. L'étude indique également que les quantités de phosphore présentes dans les divers cours d'eau n'ont pas diminué depuis 1980. Cette situation est expliquée en partie par le fait qu'en 1987, plus de 40 % des établissements de la province demeuraient non conformes aux dispositions réglementaires concernant l'entreposage. Toutefois, la cause principale est attribuée au peu de succès des moyens retenus pour enrayer les épandages à l'automne et en quantité excédant les besoins des plantes, notamment vis-à-vis les exploitations en surplus de lisiers. Il est raisonnable de croire que la qualité des eaux aurait été davantage détériorée sans la mise en place de dispositions réglementaires limitant l'expansion des élevages sur fumier liquide des exploitations en surplus de fumiers, et dans le cas de la rivière L'Assomption, sans le programme de réduction volontaire des exploitations.

Les lacunes identifiées au niveau des moyens réglementaires se rapportent à la difficulté de contrôle des normes sur les quantités de fumiers à épandre selon les cultures et des ententes d'épandage entre les éleveurs en surplus et les receveurs de lisier, et à l'absence de dates réglementaires pour le contrôle des périodes d'épandage. Le manque de complémentarité dans l'action et l'orientation des ministères de l'Environnement et de l'Agriculture, l'absence d'une approche stratégique intégrant les volets municipal et industriel ainsi que la faiblesse des moyens complémentaires à la réglementation comme la formation, l'information, la promotion de bonnes pratiques, la recherche et l'assistance financière sont également mentionnés.

Concernant les eaux souterraines, l'étude souligne que l'atteinte des objectifs est plus difficile à évaluer à cause du peu de surveillance réalisée, mais que quelques données locales obtenues permettent de croire que certaines nappes souterraines situées dans des zones à forte concentration d'élevages seraient, au moins localement, contaminées.

La détérioration de la qualité de l'air par les odeurs a été freinée par la Directive ministérielle sur l'air, mais des lacunes ont été observées notamment concernant les assises techniques, ce qui a amené le gouvernement en 1987 à mandater le Ministère d'élaborer avec ses partenaires du monde agricole et municipal une méthode appuyée sur de meilleures bases scientifiques.

**PROGRAMME D'AIDE À L'AMÉLIORATION DE LA GESTION DES FUMIERS**

Suite à l'évaluation de la réglementation en 1987, le gouvernement a décidé de poursuivre la récupération des usages des cours d'eau et de l'environnement en milieu agricole par le biais d'un programme d'intervention comportant deux volets complémentaires, soit une nouvelle réglementation plus contraignante et un programme d'aide financière. A cet effet, le Programme d'aide à l'amélioration de la gestion des fumiers (PAAGF) est entré en vigueur en juillet 1988 et des modifications au
Règlement sur la prévention de la pollution des eaux par les établissements de production animale ont été proposées pour appuyer le PAAGF (projet de Règlement publié en 1988).

ÉLÉMENTS DU PROGRAMME D'AIDE ET RÉALISATIONS

Le PAAGF encourage la mise en place de structures adéquates d'entreposage des déjections animales et vise les objectifs suivants

! réduire la pollution des eaux souterraines et de surface et la pollution de l'air;
! réduire le volume des eaux de dilution du fumier, lisier ou purin lors de l'entreposage;
! valoriser l'utilisation rationnelle du fumier, lisier ou purin comme fertilisant et amendement des sols agricoles et encourager les épandages au printemps et pendant la saison de végétation;
! encourager le traitement des eaux de laiterie de ferme.


Le PAAGF proposait des investissements de 538 M$ sur 10 ans, dont 388 M$ par le gouvernement et 150 M$ par les producteurs agricoles eux-mêmes. Les sommes déjà investies par les agriculteurs avant 1988 étaient estimées à 200 M$ et visaient principalement la construction de structures d'entreposage. Les montants dépensés par le gouvernement dans le PAAGF totalisent sur 7 ans quelque 103 M$, principalement pour l'entreposage des déjections animales, mais également pour les autres éléments du programme, soit l'achat d'équipements spécialisés, la recherche et développement, la promotion et démonstration, la gestion des surplus de lisiers, la gestion du programme et le suivi environnemental (Tableau 5).

L'état d'avancement des réalisations diffère cependant selon les éléments du programme (Tableau 6).

**Entreposage** - La construction et la réparation de quelque 4000 ouvrages d'entreposage a permis l'entreposage étanche d'environ quatre millions de mètres cubes de déjections animales, dont les cas les plus graves de pollution. Toutefois, un peu plus de 10 000 des 30 000 exploitations d'élevage ne disposent pas encore d'ouvrages d'entreposage conformes à la réglementation, et 10 000 autres sont exemptées de l'obligation réglementaire.

**Équipements spécialisés** - La réalisation de près de 600 projets visaient l'acquisition d'équipements spécialisés, principalement pour la réduction des eaux de dilution, le traitement des eaux de laiterie et l'épandage en post-levée a contribué à une meilleure gestion des effluents d'élevage. L'effort doit toutefois être accentué à ce chapitre, notamment dans les zones de surplus de lisiers.

**Recherches et développement** - En plus de former une expertise québécoise multidisciplinaire et de créer un partenariat efficace entre des firmes privées, des universités et des centres de recherche, le 5 M$ investis en recherche et développement pour réaliser 45 projets auront permis d'acquérir des connaissances et de développer des outils ou techniques pour arriver à réduire l'effet sur l'environnement de la gestion des fumiers. Les projets réalisés touchaient la valorisation des effluents d'élevage, la production et l'épandage des fumiers, le contrôle des odeurs, les eaux
résiduaires ainsi que le suivi environnemental. Un symposium tenu en septembre 1992 (MENVIQ, 1992) a permis de présenter à quelques 200 conseillers agricoles des résultats des projets maintenant rendus à l'étape du transfert technologique.

**Promotion et démonstration** - Ce volet du programme vise à promouvoir, en particulier auprès des agriculteurs, les pratiques de gestion des élevages d'animaux permettant de prévenir et de corriger la pollution de l'environnement. Le projet de sensibilisation de ses membres à l'environnement piloté par les Fédérations régionales de Québec, LévisBellechasse et Lotbinière-Mégantic de l'Union des producteurs agricoles (UPA) constitue une première réalisation dont l'effet promotionnel est essentiel à l'atteinte de résultats environnementaux.

**Gestion des surplus** - Une première étude réalisée par STATBEC (1989) a permis d'établir que les surplus de lisiers pourraient être acceptés sur un pourcentage des superficies disponibles cultivées par les receveurs potentiels variant de 22 à 34 % selon les bassins. Des études subséquentes réalisées par LGL (1990 a) et b) et BPR (1990) ont permis d'établir que le volume de surplus de lisiers à gérer dans les bassins des rivières Chaudière, L'Assomption et Yamaska se situe à près de quatre millions de mètres cubes. Entre 1990 et 1992, le MAPAQ a validé ces évaluations sur le terrain et réalisé une campagne de promotion et sensibilisation auprès de ces exploitants. La création en 1994 de trois organismes régionaux de gestion des surplus dans les trois bassins aux prises avec le problème le plus aigu de concentration d'élevage constitue une étape importante au niveau de la prise en charge par le milieu des solutions à mettre en œuvre.

**Suivi environnemental** - Ce volet a permis notamment de mesurer les pertes liées à des pratiques répandues comme l'entreposage des fumiers sur le sol et l'épandage de lisier sur le maïs à des doses parfois excessives. D'autres projets réalisés en collaboration avec Agriculture Canada, l'INRS-Eau et le MAPAQ visent à acquérir des données sur les incidences environnementales des pratiques d'entreposage et d'épandage. De plus, depuis 1988, la qualité des eaux de surface de six sous-bassins versants agricoles est suivie en vue de mesurer l'impact du PAAGF.

**MODIFICATIONS RÉGLEMENTAIRES PROPOSÉES**

Afin de supporter le PAAGF, le Ministère devait se donner une nouvelle réglementation plus contraignante relative à l'entreposage et à l'épandage. C'est alors qu'un nouveau règlement sur la prévention de la pollution des eaux par les établissements de production animale a été préparé en 1988 pour être prépublié en septembre de la même année après les rencontres et discussions avec le MAPAQ et l'UPA.

Cette réglementation visait principalement à renforcer les dispositions visant à limiter l'expansion des élevages dans les zones de concentration et à permettre une utilisation des fumiers plus respectueuse de l'environnement. Les nouvelles normes proposées consistaient à

- interdire l'expansion des élevages dans les zones de concentration sauf si l'exploitant est propriétaire ou locataire pour au moins 10 ans, selon un acte notarié, des superficies requises pour l'épandage des fumiers, ces superficies devant être situées à moins de 10 km des bâtiments d'élevage
- fixer à 0,35 hectare par unité animale (ha/UA) la superficie requise dans le cas d'une demande de certificat d'autorisation et à 0,30 ha/UA dans les autres cas tout en permettant des superficies requises réduites dans le cas d'une entente d'au moins 5 ans avec un organisme de gestion des surplus
simplifier les normes de localisation des installations d'élevage

interdire l'épandage entre le 1er novembre et le 1er avril

fixer à 60 mètres cubes par hectare la quantité maximale de lisier pouvant être épandue sans un plan de fertilisation préparé par un agronome

obliger l'entreposage ou le traitement des eaux de laiterie de ferme.

Ce projet de règlement n'a pu franchir l'étape de la publication finale en raison de l'objection des intervenants du milieu, en particulier les producteurs agricoles.

**LACUNES IDENTIFIÉES ET AVENUES DE SOLUTION**

Les modifications réglementaires proposées en 1988 n'ayant pas été adoptées et les efforts financiers et promotionnels vis-à-vis l'utilisation rationnelle des fumiers étant demeurés marginaux, les pratiques d'épandage n'ont pratiquement pas été modifiées empêchant de ce fait la réalisation d'une partie importante des objectifs du PAAGF.

C'est effectivement au chapitre des pratiques d'épandage qu'une intervention de dépollution dans le secteur agricole donnerait les résultats les plus importants. Une étude sur les principaux tributaires du fleuve St-Laurent, réalisée en 1988 (Direction de l'assainissement agricole, 1988), indique que l'épandage des surplus de fumiers hors des régions de concentration d'élevage et l'épandage des fumiers au printemps permettrait une réduction possible des apports d'azote de 17 et 11 respectivement, comparativement à 6 % avec la construction d'ouvrages d'entreposage. Une étude plus récente (Gangbazo et al., 1995) confirme que les pertes d'azote ammoniacal dans les eaux sont deux à trois fois plus élevées lorsque l'épandage s'effectue en excès et à l'automne qu'en cours de saison de végétation à des doses correspondant aux besoins de la culture. Le dépassement des normes pour le phosphore dans les cours d'eau dont le bassin supporte une agriculture intensive demeure également préoccupant (Tableau 2). Une étude en Hollande (Breeuwsma et al., 1992) a établi un lien entre une fertilisation excessive en phosphore consécutive à une forte densité d'élevage et une concentration élevée en phosphore dans les cours d'eau, en montrant que le phosphore peut être perdu non seulement par érosion, mais également par lessivage lorsque le sol devient saturé en cet élément. Des études plus récentes réalisées aux États-Unis (Sharpley et al., 1994) et au Québec (Simard et al., 1993; 1995) tendent à confirmer ce lien. Les dernières études québécoises indiquent que même les sols en prairies des fermes laitières qui ne sont pas en surplus peuvent constituer un risque pour la contamination des cours d'eau par le phosphore, et suggèrent d'éviter la fertilisation en phosphore à l'automne de même qu'en excès des besoins des cultures.

La publication en août 1994 du projet de Règlement sur la réduction de la pollution d'origine agricole (gouvernement du Québec, 1994) comportant une norme sur le phosphore du sol visait notamment à arrêter la progression de l'accumulation excessive de phosphore dans les sols consécutive à la surfertilisation, en particulier dans les zones de forte concentration d'élevage. Ce projet de règlement couvrant la protection de l'eau, de l'air et du sol est basé sur le plan de fertilisation à la ferme signé par un agronome et prenant en considération tous les fertilisants incluant les engrais minéraux, ainsi que sur la tenue d'un registre d'épandage. Il propose également des bandes de protection des eaux qui ne sont pas en surplus peuvent constituer un risque pour la contamination des cours d'eau par le phosphore, et suggèrent d'éviter la fertilisation en phosphore à l'automne de même qu'en excès des besoins des cultures.

Le projet de règlement a fait l'objet de commentaires de divers organismes des secteurs agricole, municipal, environnemental...
et de la santé. Alors que l'UPA préconise une approche davantage axée sur la formation et l'information, les groupes environnementaux souhaitent plutôt la mise en place d'un outil réglementaire supporté par un contrôle adéquat. Le secteur de la santé souhaite pour sa part que les règles de l'art agronomique relatives à la fertilisation soient encadrées par un guide à cause d'un manque de prise en compte de l'environnement et ceci malgré la publication de nouvelles grilles de fertilisation revisant à la baisse les besoins de phosphore et en azote (CPVQ, 1994). Pour sa part, le monde municipal souhaite que la pollution de l'air soit régie par le biais de leur réglementation lorsqu'il s'agit de nuisance, comme dans le cas des odeurs.

Différentes avenues devront être examinées pour apporter une solution aux problèmes soulevés par les intervenants. L'effet désincitatif de l'obligation d'un plan chez les receveurs potentiels de surplus devra notamment être contré par le biais d'un moyen approprié. Il en va de même pour les autres normes relatives à l'épandage (phosphore, périodes, bandes de protection).

L'épandage des lisiers, sans excéder les besoins des plantes en phosphore pour les exploitations en surplus, est facilité par les éléments favorisant le recrutement de nouveaux receveurs (STATBEC, 1989), tels:

- bonne caractérisation des lisiers et dosage adapté aux besoins des plantes (analyses) et plan
- utilisation de techniques d'épandage réduisant les odeurs
- méthodes d'épandage limitant la compaction des sols.

Une table de concertation sur le projet de Règlement sur la réduction de la pollution d'origine agricole, composée de représentants des quatre secteurs concernés, travaille présentement à dégager des consensus en vue de l'adoption d'ici quelques mois d'un nouveau règlement. Les travaux de cette table devraient apporter d'autres avenues de solution intéressantes comme la sensibilisation, et la formation des agriculteurs et conseillers, ainsi que l'harmonisation des programmes d'aide financière en fonction des critères environnementaux.

**PERSPECTIVES D'AVENIR**

L'expansion des élevages au cours de la prochaine décennie sera influencée par les accords internationaux sur le commerce et par la révision des règlements et des programmes d'aide financière qui en découlent, notamment les mesures touchant l'environnement.

Sur le plan réglementaire, la tendance à venir devrait viser à informer et à responsabiliser l'exploitant agricole et les conseillers agricoles vis-à-vis l'aspect environnemental. Une telle approche devrait inciter notamment les exploitations d'élevages aux prises avec des surplus de fumiers, ou d'éventuels promoteurs d'élevages intensifs, à intégrer dans les coûts de leur projet le transport des fumiers pour permettre un épandage à des périodes propices et n'excédant pas les besoins en azote et en phosphore des cultures, ou les coûts de traitement.

La prise de conscience récente de la capacité limitée du milieu naturel à supporter une agriculture intensive et de la valeur des lisiers et des fumiers en tant que ressources devrait amener une utilisation rationnelle de ces derniers.

Pour les projets de grande envergure, la réglementation sur l'évaluation des impacts sur l'environnement permettra d'utiliser une approche préventive dans les zones dont la capacité de support n'est pas encore dépassée, et d'obliger le promoteur à prévoir les coûts de gestion des surplus de fumiers en vue d'assurer la protection de l'environnement.

Sur le plan du contrôle des nuisances consécutives aux odeurs, les municipalités pourront vraisemblablement légiférer pour
limiter la taille des nouveaux élevages en fonction de la capacité du milieu.

Un exercice actuellement en cours dans le Bas-Saint-Laurent vise à identifier les critères environnementaux devant encadrer l'implantation de l'industrie porcine dans cette région en fonction de sa capacité de support. Ces critères sont établis par une table de travail constituée de représentants du milieu et des ministères concernés. Les secteurs agricole, municipal, environnemental et de la santé y sont représentés. Cette approche constitue une alternative intéressante pour l'avenir.

CONCLUSION

L'intensification et la concentration des élevages au cours des dernières décennies ont entraîné la dégradation de la qualité de l'environnement, notamment au niveau des cours d'eau, et montré la sensibilité d'une ressource dont on croyait la capacité plus grande.

À partir de 1981, une réglementation a permis d'amorcer les correctifs sur l'entreposage qui se sont poursuvis avec le Programme d'aide à l'amélioration de la gestion des fumiers (PAAGF), et de contrôler l'expansion des élevages dans les zones de concentration. Toutefois, les résultats environnementaux sont incomplets dû à la faiblesse des moyens retenus pour contrôler les épandages (doses, dates) principalement dans les zones à forte concentration de fermes en surplus.

Une approche réglementaire basée sur la responsabilisation des agriculteurs et des professionnels, un plan de fertilisation tenant compte de l'environnement et accompagné d'un registre d'épandage, ainsi qu'une révision des programmes d'aide financière pour favoriser de meilleures pratiques de fertilisation respectueuses de l'environnement, seront des moyens essentiels à l'atteinte de résultats viables. Des ressources devront de plus être consacrées à la formation et à l'éducation.

BIBLIOGRAPHIE


# TABLEAU 1. QUELQUES DONNÉES ILLUSTRANT LES CHANGEMENTS SURVENUS ENTRE 1951 ET 1991 DANS L’ÉLEVAGE ET LA CULTURE AU QUÉBEC

<table>
<thead>
<tr>
<th>ÉLEVAGES</th>
<th>1951</th>
<th>1991</th>
<th>FACTEUR DE VARIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nombre total de fermes</td>
<td>134 000</td>
<td>38 000</td>
<td>-35</td>
</tr>
<tr>
<td>Nombre total de fermes pratiquant l'élevage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>porcs</td>
<td>134 000</td>
<td>(1992) 30 000</td>
<td>-4,5</td>
</tr>
<tr>
<td>volailles</td>
<td>89 600</td>
<td>3 600</td>
<td>-24,9</td>
</tr>
<tr>
<td>bovins laitiers</td>
<td>92 300</td>
<td>4 300</td>
<td>-21,5</td>
</tr>
<tr>
<td>bovins de boucherie</td>
<td>109 400</td>
<td>14 100</td>
<td>-7,8</td>
</tr>
<tr>
<td></td>
<td>7 600</td>
<td>8 500</td>
<td>1,1</td>
</tr>
<tr>
<td>Nombre d’animaux</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>porcs</td>
<td>1 108 000</td>
<td>2 909 000</td>
<td>2,6</td>
</tr>
<tr>
<td>volailles</td>
<td>10 513 000</td>
<td>24 749 000</td>
<td>2,4</td>
</tr>
<tr>
<td>bovins laitiers</td>
<td>1 106 000</td>
<td>744 000</td>
<td>-1,5</td>
</tr>
<tr>
<td>bovins de boucherie</td>
<td>93 000</td>
<td>248 000</td>
<td>2,7</td>
</tr>
<tr>
<td>Nombre d’animaux par ferme</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>porcs</td>
<td>12</td>
<td>808</td>
<td>67,3</td>
</tr>
<tr>
<td>volailles</td>
<td>114</td>
<td>5756</td>
<td>50,5</td>
</tr>
<tr>
<td>bovins laitiers</td>
<td>10</td>
<td>53</td>
<td>5,3</td>
</tr>
<tr>
<td>bovins de boucherie</td>
<td>12</td>
<td>29</td>
<td>2,4</td>
</tr>
<tr>
<td>Volume total de fumier (Mm$^3$)</td>
<td>24</td>
<td>24</td>
<td>Négligeable</td>
</tr>
<tr>
<td>Quantité de matière active fertilisante (N+P+K) d'origine animale (t)</td>
<td>288 000</td>
<td>288 000</td>
<td>Négligeable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CULTURES</th>
<th>1951</th>
<th>1991</th>
<th>FACTEUR DE VARIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficies en culture (ha)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td>2 302 000</td>
<td>1 638 000</td>
<td>-1,4</td>
</tr>
<tr>
<td>maïs</td>
<td>34 000</td>
<td>326 000</td>
<td>9,6</td>
</tr>
<tr>
<td>céréales</td>
<td>683 000</td>
<td>320 000</td>
<td>-2,1</td>
</tr>
<tr>
<td>fourrage</td>
<td>1 479 000</td>
<td>862 000</td>
<td>-1,7</td>
</tr>
<tr>
<td>pâturage</td>
<td>1 087 000</td>
<td>271 000</td>
<td>-4,0</td>
</tr>
<tr>
<td>Engrais chimiques utilisés t</td>
<td>1 205 002</td>
<td>4 825 004</td>
<td>40</td>
</tr>
<tr>
<td>Quantité de matières actives (N+P+K) des engrais chimiques (t)</td>
<td>81 000$^3$</td>
<td>245 000$^I$</td>
<td>30</td>
</tr>
<tr>
<td>Matière active des engrais chimiques par hectare cultivé (k /ha)</td>
<td>35</td>
<td>150</td>
<td>43</td>
</tr>
<tr>
<td>ÉLEVAGES ET CULTURES</td>
<td>1951</td>
<td>1991</td>
<td>FACTEUR DE VARIATION</td>
</tr>
<tr>
<td>Nombres d’animaux par hectare en culture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>porcs</td>
<td>0,5</td>
<td>1,8</td>
<td>3,6</td>
</tr>
<tr>
<td>volailles</td>
<td>4,6</td>
<td>15,1</td>
<td>3,3</td>
</tr>
<tr>
<td>bovins laitiers</td>
<td>0,5</td>
<td>0,5</td>
<td>1,0</td>
</tr>
<tr>
<td>bovins de boucherie</td>
<td>0,04</td>
<td>0,15</td>
<td>3,6</td>
</tr>
<tr>
<td>Matières actives totales par hectare cultivé (kg/ha)</td>
<td>160</td>
<td>325</td>
<td>20</td>
</tr>
<tr>
<td>Exploitations en surplus de lisier</td>
<td>2</td>
<td>3 100$^2$</td>
<td>-</td>
</tr>
<tr>
<td>Municipalités en surplus de lisier</td>
<td>0</td>
<td>865</td>
<td>-</td>
</tr>
</tbody>
</table>

Sources : Statistique Canada 1951 et 1992 à l’exception des notes 1, 2, 3, 4 et 5 1.
3. Calculé selon le même taux que 1966 selon Agriculture Canada (1995)

<table>
<thead>
<tr>
<th>CRITÈRE DE QUALITÉ (unité)</th>
<th>AZOTE AMMONIACAL 0,5 (mg/L N)</th>
<th>COLIFORMES FÉCAUX 200 (col./100 ml)</th>
<th>PHOSPHORE TOTAL 0,030 (mg/L P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIVIÈRE</td>
<td>EAU brute destinée à l’approvisionnement en eau potable</td>
<td>BAIGNADE (% )</td>
<td>EUTROPHISATION DU MILIEU AQUATIQUE (%)</td>
</tr>
<tr>
<td>Etchemin</td>
<td>5,6</td>
<td>50,7</td>
<td>96,6</td>
</tr>
<tr>
<td>Chaudière</td>
<td>2,2</td>
<td>51,3</td>
<td>82,1</td>
</tr>
<tr>
<td>Bécancour</td>
<td>2,5</td>
<td>45,9</td>
<td>69,9</td>
</tr>
<tr>
<td>Nicolet</td>
<td>1,8</td>
<td>49,2</td>
<td>84,4</td>
</tr>
<tr>
<td>Nicolet Sud-Ouest</td>
<td>3,5</td>
<td>44,4</td>
<td>99,2</td>
</tr>
<tr>
<td>Saint-François</td>
<td>0,0</td>
<td>42,6</td>
<td>96,8</td>
</tr>
<tr>
<td>Yamaska</td>
<td>15,9</td>
<td>56,9</td>
<td>100,0</td>
</tr>
<tr>
<td>Richelieu</td>
<td>0,9</td>
<td>44,7</td>
<td>93,0</td>
</tr>
<tr>
<td>L’Assomption</td>
<td>3,5</td>
<td>90,8</td>
<td>100,0</td>
</tr>
</tbody>
</table>

Source: Gouvernement du Québec (1993)

TABLEAU 3. ENVERGURE DES PHÉNOMÈNES DE DÉGRADATION DES SOLS MINÉRAUX EN MONOCULTURE POUR CERTAINES RÉGIONS (SUPERFICIE EN HECTARES)

<table>
<thead>
<tr>
<th>RÉGION</th>
<th>SUPERFICIE EN MONOCULTURE</th>
<th>DÉTÉRIORATION DE LA STRUCTURE</th>
<th>DIMINUTION DE LA MATIÈRE ORGANIQUE</th>
<th>COMPACTAGE</th>
<th>SURFERTIL-ISATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Québec</td>
<td>22 030</td>
<td>17 500</td>
<td>5 660</td>
<td>4 000</td>
<td>9 760</td>
</tr>
<tr>
<td>Beauce/Appalaches</td>
<td>4 320</td>
<td>2 925</td>
<td>770</td>
<td>250</td>
<td>1 440</td>
</tr>
<tr>
<td>Bois-Francs</td>
<td>59 100</td>
<td>53 540</td>
<td>33 310</td>
<td>11 240</td>
<td>23 825</td>
</tr>
<tr>
<td>Estrie</td>
<td>16 019</td>
<td>12 220</td>
<td>2 650</td>
<td>1 070</td>
<td>2 540</td>
</tr>
<tr>
<td>Richelieu/Saint-Hyacinthe</td>
<td>153 200</td>
<td>141 300</td>
<td>100 020</td>
<td>27 060</td>
<td>114 410</td>
</tr>
<tr>
<td>Sud Ouest de Montréal</td>
<td>102 420</td>
<td>96 000</td>
<td>65 280</td>
<td>28 140</td>
<td>84 655</td>
</tr>
<tr>
<td>Nord de Montréal</td>
<td>65 000</td>
<td>52 300</td>
<td>31 700</td>
<td>7 930</td>
<td>43 840</td>
</tr>
</tbody>
</table>

TOTAL PROVINCIAL: 485 790 428 555 252085 100 800 308 190

Source: Tabi et coll., 1990
TABLEAU 4. **RESSOURCES CONSACRÉES À L'ASPECT ENVIRONNEMENTAL DE LA GESTION DES ÉTABLISSEMENTS DE PRODUCTION ANIMALE**

<table>
<thead>
<tr>
<th>VOLETS</th>
<th>ANNÉES</th>
<th>RESSOURCES TOTALES SUR 7 ANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestion du règlement (MENVIQ)</td>
<td>1980-1987</td>
<td>70,7 pers/année</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 386 000$</td>
</tr>
<tr>
<td>Inventaires agricoles (MENVIQ)</td>
<td>1980-1987</td>
<td>211,3 pers/année</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 803 000$</td>
</tr>
<tr>
<td>Intervention d'assainissement (MENVIQ)</td>
<td>1980-1987</td>
<td>70,2 pers/année</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 282 000$</td>
</tr>
<tr>
<td>Recherche et développement</td>
<td>1980-1987</td>
<td>15 pers/année</td>
</tr>
<tr>
<td>MENVIQ</td>
<td></td>
<td>3 500 000$</td>
</tr>
<tr>
<td>Plan spécial d'intervention dans le bassin de L'Assomption (MAPAQ)</td>
<td>1982-1987</td>
<td>272 000$</td>
</tr>
<tr>
<td>- équipe</td>
<td>1984-1987</td>
<td>272 000$</td>
</tr>
<tr>
<td>- programme réduction volontaire</td>
<td>1985-1986</td>
<td>7 220 000$</td>
</tr>
<tr>
<td>Programme de subvention aux producteurs laitiers (MAPAQ)</td>
<td>1983-1987</td>
<td>1 060 000$</td>
</tr>
<tr>
<td>Assistance financière à l'entreposage et à l'épandage du lisier de réduction porcine (A.S.R.A.)</td>
<td>1981-1986</td>
<td>1 867 000$</td>
</tr>
<tr>
<td>Recherche MAPAQ</td>
<td>1981-1986</td>
<td>300 000$</td>
</tr>
<tr>
<td>CRSAQ (Conseil de la recherche et des services agricoles du Québec)</td>
<td>1981-1986</td>
<td>450 000$</td>
</tr>
</tbody>
</table>

Total des ressources consacrées à ce dossier entre 1980 et 1987

! par le MENVIQ 12 585 000 $
! par le MAPAQ 11 169 000 $*
! par les deux ministères 23 754 000 $

*Ce montant n'inclut pas tout l'encadrement technique offert par le MAPAQ

<table>
<thead>
<tr>
<th>ÉLÉMENTS DU PROGRAMME</th>
<th>INVESTISSEMENTS GOUVERNEMENTAUX PROPOSÉS EN 1988 (M$)</th>
<th>MONTANTS DÉPENSES AU 31 MARS 1995 (M$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structures et crédit pour l’investissement</td>
<td>336,3</td>
<td>83,3</td>
</tr>
<tr>
<td>Équipements spécialisés</td>
<td>8,0</td>
<td></td>
</tr>
<tr>
<td>Recherche et développement</td>
<td>5,0</td>
<td>5,0</td>
</tr>
<tr>
<td>Promotion et démonstration</td>
<td>5,0</td>
<td>1,6</td>
</tr>
<tr>
<td>Gestion des surplus</td>
<td>10,0</td>
<td>2,0</td>
</tr>
<tr>
<td>Gestion du programme et suivi environnement</td>
<td>23,7</td>
<td>11,2</td>
</tr>
<tr>
<td><strong>MONTANT TOTAL :</strong></td>
<td><strong>388,0</strong></td>
<td><strong>103,1</strong></td>
</tr>
</tbody>
</table>
TABLEAU 6. RÉALISATIONS DANS LE CADRE DU PROGRAMME D'AIDE À L'AMÉLIORATION DE LA GESTION DES FUMIERS (PAAGF)

<table>
<thead>
<tr>
<th>ÉLÉMENTS' DU PROGRAMME</th>
<th>PRINCIPALES RÉALISATIONS</th>
</tr>
</thead>
</table>
| Structures d'entreposage et crédit pour investissement | ! Construction et réparation de quelque 4000 ouvrages d'entreposage  
! Entreposage étanche de quelque 4 millions de m³ de déjections animales |
| Équipements spécialisés                | ! Quelque 600 projets d'acquisition d'équipements spécialisés  
- réduction des eaux de dilution  
- épandage en post-levée  
- traitement des eaux de laiterie  
- compostage |
| Recherche et développement            | ! 45 projet subventionnés sur les thèmes  
- valorisation des effluents d'élevage  
- production et entreposage  
- contrôle des odeurs  
- eaux résiduaires  
- mesure et suivi environnemental  
( Symposium septembre 1992) |
| Promotion et démonstration            | ! Projet de sensibilisation UPA Québec, Lévis- Bel lechasse et Lotbinière-Mégantic |
| Gestion des surplus                   | ! Étude STATBEC (1989) établissant de 22 à 34 % l'acceptabilité des surplus de lisiers par les receveurs  
! Études LGL et BPR (1990) établissant à près de 4 M m³ des surplus à gérer  
! Sensibilisation et promotion, et validation sur le terrain de l'évaluation des surplus (MAPAQ de 1990 à 1992)  
! Création en 1994 de 3 organismes de gestion des surplus  
- L'Assomption; COGEO (Coopérative)  
- Yamaska; OGE (syndicat)  
- Chaudière; FERTIOR (coopérative) |
| Suivi environnemental                 | ! 6 projets sur les incidences environnementales des pratiques d'entreposage et d'épandage  
! 6 sous-bassins versant agricoles échantillonnés et suivis pour la qualité des eaux |
Charlie Iberg
Idelle Farm Langley, B.C.

- President of B.C. Artificial Insemination Centre
- Executive Director of Semex Canada
- Director of B.C. Federation of Agriculture
- Chairman of B.C. Agricultural Environmental Protection Council
- Owns and operates a family dairy farm in B.C.

The goal for the Canadian Dairy Industry by the year 2005 is to be in a position to deliver ample high quality competitively-priced product to consumers in Canada and Worldwide.

Where are we today? Is our goal achievable? How do we get there? What can Government do to help?

The Canadian Dairy Industry has enjoyed many years of stable prices, markets and production. As a result, the condition of our industry is as follows:

COWS

Canadian Dairy breeds, Holstein in particular, are recognized as being "state of the art" worldwide. This has been made possible partly as a result of superior uninterrupted programs related to identification, milk recording, and classification.

BUILDINGS AND EQUIPMENT

Recent years have seen numerous dairy farms shut down with those remaining picking up the slack and expanding usually into modern laboursaving structures. Rapid capital depreciation for environmental projects is greatly appreciated.

Perhaps adding rapid depreciation on other buildings would help also. Similarly, as newer, more efficient buildings with equipment have been developed worldwide, Canadian dairymen have had the dollars to buy and try them.

HUMAN RESOURCES

Dairy Farms across Canada have been rapidly turning into family businesses rather than sole proprietorships. Sons and daughters, relatives or friends have found ways to work together profitably.

It is very typical today, for well educated, enthusiastic young people to be found providing much of the energy and direction on the Canadian dairy farm. This trend is almost certain to continue.
LAND

Land is a vital part of every dairy farm. It provides feed for cattle and a means to recycle manure and waste water. In my province, British Columbia, land for agriculture has become extremely short in supply. The lack of affordable land, will in years to come, greatly restrict expansion of the B.C. livestock industry. Alberta has shown some concern as to the environmental impacts of dense livestock populations in some areas of that province also. Saskatchewan and Manitoba may be too far from high priced or fluid markets to be very competitive currently.

RECENT TRENDS

Very recent trends have seen some of the gloom over the loss of Article 112C disappear with a spirit of optimism rise as our dollar falls. There is strong interest among the younger producers to maintain profitability levels through better management, larger operations, etc. Several herds in B.C. are at 200 plus milking cows with the average herd size being 80 cows. Again, this trend to increase may be limited in B.C. by land shortages.

MAJOR PROBLEMS

An amazing number of problems can be solved when adequate on-farm-dollars are available. In B.C. a major problem has been to make on-farm adjustments to achieve sustainable farming practices. Rapidly rising hay and grain prices and falling milk prices in B.C. have caused concern. BST, and the effect it could have on our markets, has been worrisome. Diet trends can damage sales and may limit future domestic sales. A very large benefit to the Canadian economy has been sales of Canadian genetics abroad. Semen, embryo, and live dairy bull sales were nearly 50 million dollars through Semex Canada during 1994 alone. Financial support of milk recording and genetic evaluation, which is a costly program, has been given by Government in the past several decades. This support under GATT is a green program. Our federal and provincial Governments are threatening to back away from support of these programs. This could mean a loss of cow numbers on test, and our competitiveness worldwide could suffer. On technical research, with regard to nutrition and crop production, this could likely be carried out quite successfully on commercial dairy farms rather than on "research farms".

In B.C., problems related to environmental issues among all commodities are dealt with by the Agricultural Environmental Protection Council. The AEPC is made up of Ministry of Agriculture, Ministry of Environment, Federal Department of Fisheries, and farmers. This alliance has resulted in the co-operative resolution of many environmental problems and has provided farmers the opportunity to be part of the process to develop solutions for many environmental issues.

The most pressing issue for our commodity? There are many! With the trend and desire of most countries worldwide to have free trade, Canada must be sure that Canadian competitiveness is not jeopardized through unequal regulation and/or all other trade distorting factors. The dairy industry similarly, should ensure its future by striving for sustainability.

I believe the Canadian dairy farmer today is planning to face a meaner and leaner future. Dairy farms will almost certainly be larger family farm, multi-generation units by the year 2005. Many will relocate further away from their markets and from livestock versus people conflicts. Canadian dairy farms will deliver high quality raw milk to processors who will be expected to end up with the highest possible quality finished product that may be premium, but competitively priced. In the next 10 years, the industry will change, but not likely diminish.
It is often said that our world is changing and this certainly applies to our industry. With the continuing urbanization of our population and more recently some movement back to the countryside, agriculture, urbanites and country residential developments can find themselves in conflict situations.

Agriculture involves a certain amount of odor, noise and dust - all part of normal agricultural production practices. However, many new rural residents have come there to escape the city's noise and air pollution, only to find that agriculture creates some new nuisances for them - the smell of manure, the dust from combines, noise from tractors, etc. Intensive Livestock Operations or ILOs in particular are facing more and more pressures and demands. Technology has enabled a small percentage of our population to fill our food baskets. Entering the global economies means increased competition and efficiencies are required. We have an expanding cattle feeding industry and opportunities are still present in many areas. Many producers are diversifying while other established feeding operations are looking at economies of scale to increase their competitiveness. The economic, social and environmental concerns of society must be met in today's world.

Right to farm legislation in one form or another has been formulated in our provinces to protect producers. Alberta has a basic Agricultural Operations Act introduced in 1987. It says that a person carrying on an agricultural operation who is complying with accepted practices is not liable to any action in nuisance resulting from the agricultural operation. Ontario has the Farm Practices Protection Act that has very similar wording, but goes on to include a Farm Practices Protection Board that reviews complaints against agricultural operations. The board either dismisses complaints or orders changes made in the agricultural practices, if it is not operating within normal practices.

BC introduced its Agriculture Protection Act in 1989 that provides a defence for agricultural operations from nuisance actions if they operate within generally accepted farming practices. In nearly the same terms, New Brunswick's legislation says that an agricultural operation is
not liable in nuisance for any odor, noise or dust resulting from the agricultural operation. Nova Scotia's Agricultural Operations Protection Act has very similar provisions but uses a committee to investigate complaints and recommend action to the Minister responsible. I understand Saskatchewan has recently introduced right to farm legislation.

The Alberta Cattle Commission conducted an environmental risk assessment of the beef cattle industry in the early 1990s. As a result of this assessment and the introduction of new environmental legislation in the province, cattle producers established some objectives for an education, planning and regulatory regime to deal with siting and management of ILOs. The objectives laid out were:

- To ensure that livestock operations did meet acceptable standards to ensure human health and environmental needs.
- To clarify and simplify the regulatory regime governing siting.
- To establish an adequate code governing siting and management that would be applied equitably across the province.
- To set up a simple and effective permitting process.
- To ensure minimum distance separation requirements were applied reciprocally to avoid encroachment of non-compatible uses into areas where livestock operations were located.
- To separate nuisance issues and minimize conflict from environmental and health issues.
- To establish some effective dispute settlement mechanism to deal with conflicts.

We accomplished these objectives by working together with other livestock organizations and formed an Intensive Livestock Operations Advisory Committee in conjunction with the appropriate government departments. An agreed upon package was submitted to the government which included:

- Definition of an ILO (in the case of beef, overwintering of cows was exempted)
- A revised Code of Practice for ILOs covering siting, construction and management of such operations.
- A simple permitting process that would be used by local municipal planning authorities.
- Proposed revisions to legislation that would give the primary responsibility for permitting to local authorities and clarify the role of the Departments of Health, Environment and Agriculture.
- A peer review board to help resolve disputes with existing farm operations. Industry experts assess farm operations and recommend changes to resolve conflicts.

Our process starts with an ILO permit application and follows through a series of steps until the application is either accepted or rejected. In the event of an application requiring modification to siting location, or any variety of applicable concerns, the province supplies the engineering and technical expertise to assist in the application. There also is an appeal mechanism built in and a peer inspection is available.

**SUMMARY**

To meet all of these obligations, some generally accepted practice must be determined. For this to be scrutinized requires a process. Regulations can support development but cannot be relied upon entirely and in fact have limited development in some areas. It is very fundamental that producers be protected from unwarranted nuisance lawsuits. Most provinces have adopted some form of Right to Farm legislation to protect producers and at the same time meet society's needs including effective water pollution management, proper manure disposal, correct proximity to other residences and recreation development, and overall human health and safety. All of this will ensure that intensive Livestock Operations will continue to co-exist with society and at the same time to help strengthen our industry.
Development Permitting Process for Intensive Livestock Operations
Agricultural Practices Review Board

COMPLAINT
(unresolved by provincial departments and local government)

Agricultural Practices Review Board

Generally Accepted Practice investigation/hearing

Mediation:
At any stage the Board may attempt to mediate a resolution to the complaint.

Operator not following generally accepted practice

Board recommends specific changes and follow-up inspection

Operator not following generally accepted practice
- possible peer pressure from commodity group
- no protection in nuisance law suit launched by complainant
- possible action by Environmental Protection, Health or Local Government

Operator following generally accepted practice (enhanced protection under AOPA)

Operator following generally accepted practice (enhanced protection under AOPA)

No further action required by farmer or Board

AOPA = Agricultural Operation Practices Act
It is indeed a pleasure to be involved in this workshop not only as a participant, but also now to be able to give you a hog producer’s perspective on environmental issues and concerns. Naturally most of my comments pertain to the Manitoba experience as that is where I have been most involved. It was very interesting to hear of other provinces and how they are dealing with the issues at hand. One speaker mentioned that land use planning and the issue of acquiring permits could not be worse than they are in B.C. I can assure you they are. Let me give you some examples.

In the spring of 1994 I was asked to attend a pre-public hearing meeting for a producer who wanted to put up one bio-tech or the equivalent of 600 pigs per year (30 LWU). This actually went to a public hearing later on. This particular municipality has a hog population of 3 hogs per square mile. Another municipality that has a hog population of over 300 hogs per square mile does not require any public hearing or conditional use process for anything up to 500 LWU. This is an inconsistency that must be dealt with.

Another example is in south central Manitoba where which states that any operation larger than 200 LWU must be 1 mile from the nearest neighbour. In other words you must build in the centre of 4 sections of land which constitutes in excess of 2500 acres.

I could list many other examples of how various municipalities are reacting to livestock siting, but I believe the point has been made. Our provincial governments must make moves like they have in B.C. I have been very encouraged by listening to David Sands (from B.C.) and the work he has been involved with. It is time that municipalities either relinquished their authority or started using them in a more responsible manner.

The industry also has a vital role to play in the realm of environmental sustainability and sustainable development. The tension between absolute and balanced environment has hit a social nerve. In terms of positioning the industry in the environmental consciousness of society, it should be made clear that hog production is compatible with the environment.

Hogs produce manure. That manure when managed properly can and should be
natural plant food that benefits the producer and the landscape overall. Manure not only promotes plant growth but it also improves soil structure and quality. Remember, "waste is only waste if it is wasted".

Livestock producers by their very being embrace environmentally sound agricultural practices and techniques. It may be through the adoption of new technologies or techniques, or it may mean carrying on business as usual as many operators are already managing manure and their operations wisely. All segments of the industry have a vested interest in maintaining a clean and healthy environment.

The industry has shown leadership through the development of farm practice Guidelines. The new Guidelines as published by the Department of Agriculture are an asset in the hands of producers and local government officials. They also serve the informational needs of the private citizen. The Guidelines along with a Code of Practise and a regulation under the Environment Act, prove to be very useful tools. They were compiled by a broad base of people, including Union of Manitoba Municipalities, Manitoba Association of Urban Municipalities, Keystone Agricultural Producers, consumer associations, as well as various departments of government. Unfortunately they are not being utilized, as envisioned, by municipalities.

The establishment of technical review teams in each of the agriculture regions also demonstrates a commitment to ensure that technical aspects of a new or expanded operation are consistent with the established Guidelines. These reviews are designed to establish the technical soundness of a project prior to a conditional use hearing.

With the aid of Guidelines and technical review committees, rural councils can now review livestock applications on their technical merit and adherence to the Guidelines. However, as we very well know the life of an operation can be short lived in the political arena. The tactics of some special interest groups have been to disrupt the process and halt all expansion. In far too many instances council chambers have been subject to shouting matches with little regard to due process and fair review. Councils as well as producers are finding the process frustrating and they find themselves mired in the quagmire of a cleverly crafted chaos.

The challenge for government is to establish meaningful policies and programs which facilitate the expansion of livestock operations. If agriculture is to continue to increase in importance for the social and economic well being of the province, agricultural land must be maintained for that purpose instead of some misconstrued concept of urban expansion and control. If we continue to build our retirement homes, hobby farms, or idyllic hideaways willy nilly throughout the countryside, people will continue to come into conflict with one another. Policy must be set by the appropriate parties to maintain agricultural operations and lifestyles.

Manitoba Pork and the majority of the Province's hog producers advocate growth, but we believe it must be done in a responsible and planned manner. Everybody knows that production starts on the farm and if we are held back by undue constraints hog production will not increase.

The challenge for the hog industry and government is one of communicating the worth of agriculture to society. People need to know where their food comes from, how it is produced and why the industry is important to the continued well being of small communities, large cities and the country overall. And they need to know that food is produced in an environmentally sound and sustainable manner. People in the rural areas must show support for this sustainable development. They must realize what agriculture is all about with regard to production, and will have to face the consequences of occasional odour, dust, smoke or noise problems not normally associated with an urban lifestyle. Society must also
learn to communicate with producers in a rational manner. Unfortunately too many times when this communication starts, it is already confrontational - that needs to be resolved.

But as producers, let us not forget that communication is a two way street. Producers of all livestock, be it hogs, chickens, cattle or turkeys, need to be more sensitive to the interests and concerns of their neighbours, and in this business a neighbourhood is defined by some as living in a watershed. We need to step up our efforts to build public confidence in our industry. The most important step for this is to show an interest in the well being of neighbours as well as the environment. I believe the correct term here would be "good management".

This can't be stressed enough. We need to do this in partnership with all the industry stakeholders and government. And we need to factor in the concerns and interests of the non-farming community into our programs.

In many respects our industry is at a crossroads. We can grow and prosper in a sustainable sound manner if we garner public support through awareness and understanding. We need to do so as an industry working in partnership on goals of mutual interest. And we need to do it in concert with government at all three levels. In this way, and only in this way, will we be able to enhance the future of livestock production in this country.
PRODUCERS' PERSPECTIVES OF SITING LIVESTOCK AND POULTRY OPERATIONS - SWINE

Joe van Vulpen  
Hog Producer Amherst, Nova Scotia

Owner of Jomar Farms, a 400 sow farrow-to-finish unit in Amherst, Nova Scotia  
Director, Pork Nova Scotia  
Second Vice President, Canadian Pork Council  
Chairman of the Canadian Pork Council’s Environmental Resource Group which is responsible for the development of an Environmental Code of Practice for the Canadian hog industry

Following Gerry Friesen’s overview of the state of environmental concerns at the provincial level, I would like to discuss national issues and a few points that have come to mind from early discussions at this workshop.

First of all, I would like to bring the group up to date on the Canadian Pork Council’s Environmental Action Plan (EAP). The EAP was initiated by Christine Nymark of the Environmental Bureau of AAFC at the Pork Council’s annual meeting at Halifax in July of 1994. While Ms Nymark’s concerns were more on trade related issues, the national issues including on-farm problem areas became the motivational forum needed for the CPC to endorse an Environmental Resource Group (ERG).

This group was formed early in 1995 to lead the process and is made up of many forms of expertise. Included are several persons at this workshop including Ms Nymark, as well as your chairman, Jim Dalrymple. Others present are Dr. Suzelle Barrington of McGill University, Dr. Patni (AAFC’s Research Branch), and Gerry Friesen, a producer from Manitoba. Another key member to this Workshop is Dave Sands from British Columbia who has already described to this Workshop his experiences of producing a Code of Practice for B.C. Agriculture. David has produced the first draft of a Code of Practice for ERG.

Other areas of expertise on our ERG come from Hélène Perreault of the Fédération des producteurs de porcs du Québec, Sheila Forsyth of the National Agriculture Environment Committee, Mark Ziegler (Environmental Bureau, AAFC), Warren Gear of the Canadian Bankers Association and Marie Adam representing Environment Canada.

The CPC’s Environment Resource Group met in Jan and May of this year to discuss the best approach to the development strategy. It was agreed to work towards the development of a national code of practice which would primarily aim at promoting environmentally sound practices among pork producers and encourage some form of consistency and fairness in the development of standards by provincial and municipal regulatory authorities.

We at CPC recognize that this code will not in itself
Hog farmers will have to invest in technology and expertise that can compete in the future. Hog farmers will have to invest in technology and expertise to improve production and to obtain buying power to compete against integrators. One of my last concerns is the cost of being environmentally sound. Dr. Hein Korevaar from the Netherlands has showed us a piece of equipment to inject manure in soil. Very few farmers have the financial resources to acquire this kind of equipment. Forcing the use of this type of equipment as well as storage facilities could place a financial burden on an industry that is currently in tight financial straits. If a farmer can be environmentally sound without these financial hindrances, then why place on him or her such additional cost burdens?

The results of this workshop could prove to be beneficial to the Canadian agriculture industry. We at the CPC are doing our part in being proactive in setting guidelines for ourselves. We also recognize the importance of displaying our contribution to the economy along with our commitment toward the environment. Where we need assistance is at government levels so that farming is not being curtailed for the wrong reasons. Pork production has the potential of being an important growth industry in Canada over the next ten years. Results of this workshop along with the Code of Practice for Hogs, and government and public awareness of the industry as it relates to the environment could become major factors in realizing this projected growth.
Craig Hunter
Burnbrae Farm Lyn, Ontario

In the poultry, grain and feed industries entire career
Member: Agricultural Research Institute of Ont.
Presently Vice-President, Operations and GM of
Burnbrae Farms Ltd., Lyn, Ontario and Ferme St.
Zotique, Québec. These companies are Canada's
largest egg production and marketing operations

TRENDS & CHANGES

The poultry industry is gradually producing
less manure per pound of egg and poultry
meat produced.

In preparation for competition with U.S. egg
producers, Canadian poultry and egg
producers will be forced to operate larger
poultry operations in fewer locations. The
poultry industry must plan for this now, not
after the year 2001.

Fortunately, the manure being produced by
the majority of poultry and egg producers
today is much drier than in the past. As a
result, we will have less potential problems
with air pollution and water pollution
associated with the spreading of poultry
manure than we may have experienced a few
years ago.

Formulation of poultry feeds with lower crude
protein, higher synthetic amino acids and
lower phosphorous levels is producing
manure which contains less nitrogen and
phosphorous.

As cash croppers recognize the value of
nitrogen, phosphorous, potassium and
organic matter in poultry manure, the demand
for our manure is increasing. In the future, our poultry
manure will be an asset to our operations, not a
liability, provided we handle it properly.

In the U.S., many states are now allowing DPW
(Dried Poultry Waste) to be registered as a feed
ingredient for ruminant animals.

There is a definite trend in agriculture towards a
more "organic" type of farming with less dependence
on the use of chemicals. This trend will increase the
market for composted poultry manure as well as
unprocessed manure. Phosphorous reserves in the
U.S. are predicted to be exhausted by the year 2005.
Again, this will increase the value of poultry manure.

RESEARCH AND EDUCATION

More research is required on methods of reducing
the levels of nitrogen, phosphorous and moisture in
poultry manure.

We need a combination of research and education
in planning future composting operations.
We need to be more scientific in planning application of poultry manure to a multitude of crops. We will require accurate soil analysis, manure analysis and the requirements of the crop being grown. We must also predict the effect this will have on the water quality in the area.

**CHALLENGES**

We apparently have vast differences between provinces in guidelines and regulations affecting where we can locate new poultry facilities. Some provinces and municipalities may "scare away" potential expansion of poultry operations and force future expansion to occur in other areas, perhaps even into the U.S.

Some municipalities are attempting to ban the spreading of manure in certain areas and also ban the movement of manure from one municipality to another.

The poultry industry is concerned about numerous subdivisions and severances "popping up" in areas which could handle expansion in the poultry industry, provided we do not become surrounded by residential areas. These new residents moving to the country may have to agree to live with the odour of livestock operations which do occur from time to time.

We must put in place common sense "Codes of Practice" in Canada which will allow our poultry industry of the future to compete with our U.S. farmer competitors.

We must have access to the same fly control products as U.S. farmers, in order that we can be "good neighbours".

In the future, the poultry industry must work closely with the Ministry of Agriculture, Ministry of the Environment and the general public in order to come up with common sense solutions to the long term problems of siting future poultry buildings.
Dr. Wayne Caldwell  
Huron County Planning and Development Goderich, Ontario  

! Senior planner, Huron County Dept of Planning and Development, Goderich, Ontario  
! Associate Graduate Faculty Member with the U. of Guelph School of Rural Planning and Development  
! Has published and instructed in the areas of planning, community development, agricultural land preservation, public admin., planning methods, environment protection and the role of the province in community development  

INTRODUCTION  

The following paper outlines a dramatized discussion between a municipal council, clerk and county planner over the issue of livestock facilities within the rural community. It includes a hypothetical report prepared for review by a local township council. Although the setting is fabricated, the points of view presented have been discussed at actual municipal council meetings. All scenarios, are based on factual information and the experience of the author.

SETTING  

A Municipal Council Meeting, Somewhere in Rural Ontario  

The municipal councillor sits back and shaking his head says...  

"We've got to do something about these new large livestock operations. In our township alone we've had 15-20 of these, mostly hog barns, established over the last 10 years.

The chief building official tells me that some of these barns are costing more than a million dollars to build and that the current hog barn being built is designed to handle 4000 fat pigs at once. We've got many others designed to handle as many as 1000 sows. When two or three of these producers are spreading their manure at once, there is a stench that goes across the entire township. Why, just yesterday the reeve of a neighbouring village told me that water samples from their municipal wells were bad and that the Ministry of Environment and Energy was directing them to chlorinate their water. He tells me that while they don't know for sure he thinks that its seepage from these livestock barns. And in other townships they've got the same set of problems but also with poultry and dairy..."

The councillor starts to ramble and a second councillor, jumps into the discussion...  

"You're painting a one sided story. These producers are using some of the best..."
technologies in the world, to compete in the world market. They’re progressive and they’ve got thousands of acres to dispose of their manure on. Sure, we hear stories about bad management, but not with these farms. I think that the problems are coming from those smaller producers with outdated technology. They’re the people who are polluting the water."

A third councillor, a non-farmer recently elected to Council, has her own views...

"I don’t like what this issue and the discussion are doing to our community. Some people say that we shouldn’t allow any more houses in the country because it takes away from the potential for agriculture. They say that one of these farms with a hog barn pays $3 - 4,000 in property tax while a residence on a couple of acres only pays $1000. Some of my other neighbours say that maybe the only way to stop the contamination of our air, water and soil with pig manure is to allow even more houses, maybe these extra houses will put restrictions in place that make it harder to put up these pig barns. I don’t know what to think- it seems to me that maybe both points of view are right..."

The reeve of the township begins to note that the discussion isn’t going anywhere and attempts to move onto the next agenda item -

"We’ve talked about this before, and frankly I don’t see that we’re getting anywhere. Does anyone have any suggestions?"

In response to the question the reeve hears a barrage of suggestions...

'You should ban these big pig operations':... "Lets make sure they have the land base to dispose of their manure":...

"This is a provincial responsibility, if a problem develops let the province handle it":... "You’re all just prejudiced towards these operations-its a sign

The reeve cringes and turns to the township clerk for a suggestion. The clerk, realizing that there is a hockey game that evening, and being ever quick on his feet, offers the following...

"Well, we could consider deferring the issue and perhaps ask the County Planning Department to bring back a report to the next council meeting identifying the issues and a potential municipal response":

The reeve looks to the Councillors and there is quiet agreement. Finally, the reeve thinks to himself, we can move on to the issue of stray dogs at the north end of the Township...

SETTING:

A Municipal Council Meeting, Some-where in Rural Ontario, One Month Later

Having just heard the report from the township dog catcher the reeve invites the planner to the council table. The reeve provides a brief introduction to the topic and asks the planner to present his report.

"Let me begin Mr. Reeve, by thanking the clerk for helping me to understand the issues that have been identified by council. He has provided me with copies of the council minutes and I believe that I have a reasonable understanding of the differing points of view that have been expressed by council. I should advise, however, that the issues that have been identified are shared by other councils, both within this county and in neighbouring counties. In preparing my report I have spoken to staff in some of these other counties and also spoken with representatives of the Ministry of Agriculture, Food and Rural Affairs, The Ministry of Environment and Energy, the Conservation Authority and the County Solicitor. Moreover I have drawn upon other published reports to help identify more specifically the very real community issues that are related to this topic.
I believe that there are sufficient copies of my report for Council (the planner proceeds to circulate these) and I would like to go over this in detail. It is a relatively long report and perhaps we could defer questions until I have presented it in its entirety."

Report of The County Planning Department

prepared by Joe Planner for review by

Township of "Don't Know What To Do About Pig Manure"

July, 1995

Introduction

In many counties across Ontario, agriculture is a significant component of the economy occupying the vast majority of the land base. This agricultural industry is diversified with growth and change occurring in a number of areas. In the poultry sector, for example, there is significant growth, and in other sectors, such as hogs, there is significant reorganization and consolidation resulting in the establishment of much larger operations. This growth and change occurs for a variety of reasons reflecting an increasing emphasis on corporate scale agriculture, economies of scale, the introduction of new technologies, expanding markets, vertical integration (including the involvement of feed and slaughter companies), and an increasingly competitive marketplace driven by a global economy. This growth and change is particularly important for those areas of the province, where there is a concentration of this activity. This concentration tends to be focused in Southwestern Ontario for a variety of reasons, including locational advantages related to climate, soils, infrastructure, relative proximity to markets, a knowledgeable and progressive farm community, and the relative absence of urban development with few associated restrictions.

The continued and perhaps accelerated industrialization of the agricultural industry contributes to a number of real and perceived issues in the rural community. For as much as there are many parts of agricultural Ontario that remain predominantly rural and agricultural these areas are still within the influence of numerous major urban centres and in many rural areas there has been the gradual introduction of various forms of urban development (primarily residential) largely since the end of the Second World War. The changing nature of the rural community serves to heighten concerns which are often shared by both the farm and non-farm sector.

Ten Key Trends Affecting the Establishment of Livestock Facilities

The following section summarizes 10 key trends within the rural community that affect the establishment of livestock facilities.

1. The Rural Community as a Decreasing Component of the Country's Population
   At the national and provincial level, rural communities represent an increasingly diminished proportion of the total population. Across Canada and largely since the end of the Second World War, there has been a continuous shift in the residency of the population from rural to urban and in many rural areas there has been an exodus of population to urban communities. The result is that within Ontario in 1991, for example, only 18% of the province's population was classified as rural and only 2.1% was classified as farm. In 1941 for the country as a whole, 27% of Canada's total population lived on farms compared to just 3% in 1991 (Thibault, 1994). Correspondingly, agriculture and agricultural issues have become a much smaller component of the provincial and national agenda.

2. Rural Farm as a Decreasing Component of the Country's Rural Population
   Despite the long-term decrease in the proportion of the population which is
classified as rural, there has been population growth in many rural areas throughout the 1980’s. According to a recent report released by the federal government (Government of Canada, 1995) populations in rural and remote regions increased by 6% during this time. This trend is even more striking within Ontario where population of rural and remote areas increased by 12% between 1981 and 1991. While this growth varies regionally across the province, it is clear that while there was significant growth of 211,223 in the rural non-farm population there was a decline of 12,455 in the rural farm population between 1986 and 1991 (Table 1). These trends are evident within the most productive and agricultural areas of the province. Table 1, for example, identifies those Counties and Regions which are largely rural and located to the south and west of Toronto comprising the heart of Ontario’s agricultural industry. While these Counties and Regions include 52% of Ontario’s census farm area they received 67% of the total value of all sales. Within this key area the rural non-farm population increased by 50,123 while the farm population decreased by 6,410. This continued shift in the rural farm and non-farm composition of the population is accompanied by a corresponding increase in the potential for conflict between rural residents and livestock operations. These changes also translate into a reduction in the significance of agricultural issues provincially and federally.

Table 2, for example, provides information on the number of severance applications across the predominant agricultural areas of Ontario. While these figures include applications and not approvals, and will include many legitimate farm related severances, they are an indicator that there has been significant severance activity resulting in the creation of new lots. Although there is no single provincial data base, partial studies indicate that in at least some of the counties and regions identified in Table 2, the numbers of applications correlate to significant rural residential development (Caldwell, 1993; Ministry of Municipal Affairs, 1991). In some of the counties and regions the 1986-1991 overall increase in the rural non-farm population of 50,123 is at least partially a result of the 30,572 severance applications received between 1983 and 1992. Generally speaking there is an apparent correlation between the number of applications received by county or regional municipality and the corresponding rural population growth. The effect of the growth of this rural non-farm development is that it raises the probability of conflicts with agriculture, changes the farm/non-farm composition of local communities and by virtue of a higher population density may contribute to issues of nuisance complaints and corresponding policy that complicates the establishment of livestock operations.

3. The Growth of Rural Non-Farm Development

Related to the previous demographic trends is a significant change in the land-use composition of rural communities. This change, including the farm and non-farm mix is a result of a number of trends including the relative health of many small towns and villages, the negative perception of large urban areas, but also reflects increasing urban development in rural areas.
Table 1: Rural, Rural Farm and Rural Non-Farm Populations by Selected Counties and Regional Municipalities- 1986-1991 Comparisons

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brant</td>
<td>21040</td>
<td>3030</td>
<td>-831</td>
<td>300</td>
<td>-1131</td>
</tr>
<tr>
<td>Bruce</td>
<td>32355</td>
<td>8620</td>
<td>5018</td>
<td>-170</td>
<td>5188</td>
</tr>
<tr>
<td>Dufferin</td>
<td>14040</td>
<td>3420</td>
<td>2983</td>
<td>-375</td>
<td>3358</td>
</tr>
<tr>
<td>Elgin</td>
<td>30835</td>
<td>6130</td>
<td>1002</td>
<td>-285</td>
<td>1287</td>
</tr>
<tr>
<td>Essex</td>
<td>61130</td>
<td>8085</td>
<td>182</td>
<td>-1495</td>
<td>1677</td>
</tr>
<tr>
<td>Grey</td>
<td>37695</td>
<td>10400</td>
<td>6220</td>
<td>-715</td>
<td>6935</td>
</tr>
<tr>
<td>Hald.-Norfolk</td>
<td>51800</td>
<td>10560</td>
<td>5544</td>
<td>-775</td>
<td>6319</td>
</tr>
<tr>
<td>Huron</td>
<td>36650</td>
<td>11485</td>
<td>870</td>
<td>-505</td>
<td>1375</td>
</tr>
<tr>
<td>Kent</td>
<td>37600</td>
<td>8795</td>
<td>433</td>
<td>-675</td>
<td>1108</td>
</tr>
<tr>
<td>Lambton</td>
<td>34420</td>
<td>8975</td>
<td>2569</td>
<td>-630</td>
<td>3199</td>
</tr>
<tr>
<td>Middlesex</td>
<td>41560</td>
<td>10245</td>
<td>1716</td>
<td>-210</td>
<td>1926</td>
</tr>
<tr>
<td>Niagara</td>
<td>46275</td>
<td>8610</td>
<td>7913</td>
<td>-965</td>
<td>8878</td>
</tr>
<tr>
<td>Oxford</td>
<td>33760</td>
<td>8655</td>
<td>1364</td>
<td>40</td>
<td>1324</td>
</tr>
<tr>
<td>Perth</td>
<td>25430</td>
<td>10620</td>
<td>934</td>
<td>-40</td>
<td>974</td>
</tr>
<tr>
<td>Waterloo</td>
<td>27450</td>
<td>6590</td>
<td>1290</td>
<td>185</td>
<td>1105</td>
</tr>
<tr>
<td>Wellington</td>
<td>38940</td>
<td>10250</td>
<td>6506</td>
<td>-95</td>
<td>6601</td>
</tr>
<tr>
<td>Totals</td>
<td>570980</td>
<td>134470</td>
<td>43713</td>
<td>-6410</td>
<td>50123</td>
</tr>
<tr>
<td>Ontario</td>
<td>1632275</td>
<td>232785</td>
<td>1987681</td>
<td>-12455</td>
<td>211233</td>
</tr>
</tbody>
</table>

80
Table 2: Severance Applications Received by the Ontario Ministry of Agriculture, Food and Rural Affairs’ by Selected Counties and Region (1983-1992)

<table>
<thead>
<tr>
<th>County/Regional Municipality</th>
<th>Total number of applications 1983-1992</th>
<th>Total Number of applications per 1000 acres</th>
<th>Change- Rural Non Farm Population (1986-1991)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brant</td>
<td>943</td>
<td>4.2</td>
<td>-1131</td>
</tr>
<tr>
<td>Bruce</td>
<td>905</td>
<td>0.9</td>
<td>5188</td>
</tr>
<tr>
<td>Dufferin</td>
<td>1303</td>
<td>3.5</td>
<td>3358</td>
</tr>
<tr>
<td>Elgin</td>
<td>1415</td>
<td>3.0</td>
<td>1287</td>
</tr>
<tr>
<td>Essex</td>
<td>2649</td>
<td>5.8</td>
<td>1677</td>
</tr>
<tr>
<td>Grey</td>
<td>6903</td>
<td>6.2</td>
<td>6935</td>
</tr>
<tr>
<td>Haldimand-Norfolk</td>
<td>3759</td>
<td>5.4</td>
<td>6319</td>
</tr>
<tr>
<td>Huron</td>
<td>591</td>
<td>0.7</td>
<td>1375</td>
</tr>
<tr>
<td>Kent</td>
<td>1112</td>
<td>1.8</td>
<td>1108</td>
</tr>
<tr>
<td>Lambton</td>
<td>1297</td>
<td>1.9</td>
<td>3199</td>
</tr>
<tr>
<td>Middlesex</td>
<td>1205</td>
<td>1.5</td>
<td>1926</td>
</tr>
<tr>
<td>Niagara</td>
<td>2716</td>
<td>6.1</td>
<td>8878</td>
</tr>
<tr>
<td>Oxford</td>
<td>840</td>
<td>1.7</td>
<td>1324</td>
</tr>
<tr>
<td>Perth</td>
<td>621</td>
<td>1.1</td>
<td>974</td>
</tr>
<tr>
<td>Waterloo</td>
<td>1126</td>
<td>3.4</td>
<td>1105</td>
</tr>
<tr>
<td>Wellington</td>
<td>3187</td>
<td>4.9</td>
<td>6601</td>
</tr>
<tr>
<td>Total</td>
<td>30572</td>
<td>3.1</td>
<td>50123</td>
</tr>
</tbody>
</table>

This table is based on the total number of severance applications circulated by local municipalities and received by the Ontario Ministry of Agriculture, Food and Rural Affairs. It should be noted that the data does not distinguish between farm and non-farm severances, nor does the number of applications equate to approvals. There is no provincial database documenting the creation of rural, non-farm lots.
4. An Evolving Agricultural Industry

Since the end of the Second World War there has been increasing industrialization in the nature and scale of agricultural production. Increasing specialization, and intensification of production are evident in a number of agricultural categories. Key indicators of these trends include the following:

- Between 1971 and 1991, the total value of farm capital in Canada increased more than fivefold, from $24 billion to $131 billion in 1991 current dollars (Kimanyi, 1994).
- Between 1941 and 1991 average farm size grew from an average of 96 hectares to 242 hectares.
- The number of larger farms with annual gross farm receipts of $50,000 or more (1990 constant dollars) doubled from 55,000 in 1966 to 118,000 in 1991 (Thibault, 1994).

The livestock and poultry sector has also changed. While there are fewer dairy farms, the average herd size has more than doubled in two decades (Harrison and Broers, 1994) and in the hog industry, operations with over 527 pigs have increased from 1% of the 1971 total to 18% in 1991 (Burroughs, 1994). This is consistent with the trend towards fewer, but larger, more specialized farms.

Increasing scale and specialization in agriculture has contributed to the potential for land-use conflict between farm and non-farm interests. Whereas historically Ontario agriculture was relatively homogenous with a similar type and nature of agricultural production there are now wide differences in the size, type and management philosophy within the farm community. The result is an increasing probability of conflict, complaints and the involvement of local and upper levels of government in regulating issues related to the farm sector. The establishment or expansion of livestock facilities represents a visible and some would argue

5. Environmental Awareness

Society has become increasingly aware and concerned with issues that contribute to the degradation of the environment. In a recent study completed within two Ontario counties, environmental issues including those related to the management and handling of livestock manure were identified by groups of farmers, politicians and planning and development professionals as key to the future of rural communities (Caldwell, 1994). This environmental awareness contributes to the public being much less accepting and tolerant of issues related to agriculture and the environment. The result is a goal of ensuring that livestock and poultry facilities are established with a high degree of environmental responsibility.

6. Environmental Liability

Related to increased environmental awareness is an increasing liability that potentially exists as a result of air or water contamination from livestock waste. The potential for nuisance suits, and accidents or poor management that contaminate surface or ground water are likely to lead both farmers and their insurance companies to be increasingly careful in the establishment and maintenance of livestock facilities. Issues related to environmental liability will also, in all probability, lead municipalities to more rigorously enforce and develop by-law provisions that pertain to the establishment and potential management of livestock facilities.

7. Normal Farming Practice

Historically farmers have been treated relatively leniently in matters related to manure disposal and the environment and have often been protected by the term normal farming practices. Ontario’s Farm Practices Protection Act, for example, uses the term normal farming practices as the base against which certain ‘nuisance complaints’ are evaluated (Penfold, Mathews, Flaming and Brown, 1989). The goal of this legislation is to protect the right of farmers to farm provided that they are using normal
practices. Moreover, the application of environmental law and associated regulations have been sensitive to the farming practices normally used by farmers. The result has been the continuance of certain farm practices, particularly related to manure handling and disposal, that might be construed as normal farming practices, but which may not be in the best interest of the environment. It would seem apparent however, that given the need to ensure high environmental standards the farm community will be held increasingly responsible for manure and its proper disposal. There is, of course, a fundamental relationship between manure handling and storage and the siting of buildings.

8. The Countryside Is A Common Resource

While rural and agricultural Ontario is predominantly in private ownership, there is a view held by some in society that the countryside is a common or public resource. While many in the farm community would disagree with this view, as 3% of the total population the farm community needs to recognize that there is the probability that over time legislation and local by-laws will increasingly reflect this perspective. This is particularly true for those ubiquitous resources such as air and water that transcend private property and which clearly are public. In as much as the siting, size and management of livestock and poultry facilities can detrimentally affect the public’s view of the countryside there is the probability that this will be an increasing issue in the future.

9. Elected Officials and Environmental Regulations

With changes in society, demographics, political influence and the composition of the farm community, including the diversity between many farming operations, there is an increasing willingness on the part of elected officials to establish, implement and enforce environmental regulations and to not come to the defense of where an issue or complaint might develop. Issues related to the land base available for manure disposal, the proper use of manure and nutrient components, the type of manure storage, the distance to non-farm uses, the methods of manure disposal, and the size and type of livestock operations are examples of issues which increasingly concern elected officials.

10. Agriculture Versus Other Forms of Development

Many municipal officials seek certain levels of development within their community. As outlined within Table 2, the development of non-farm lots as a result of severance activity is a popular occurrence in much of rural Ontario. Often, however, agriculture is not valued to the same extent as other forms of development such as residential or commercial. As a result, policies are often developed and put into place that will favour non-farm development thereby posing certain obstacles to the establishment of farm and in particular livestock and poultry operations.

From the above one can conclude that there are two types of issues affecting the siting of livestock facilities. First, many of the above issues are perceptual in nature. These issues may not have any real or scientific basis but are perceived as being real by the public and in turn may generate political support leading to political action. As a result, certain legitimate and environmentally benign practices may be challenged because of the public’s negative perception or lack of tolerance. There may not, for example, be anything wrong with the storage of liquid manure in an open concrete facility or with the proper application of liquid manure, or with livestock operations on a small acreage; however, these are issues in the eyes of many and may lead to municipal regulation. Second, there are many real issues associated with the management of animal waste and the establishment of livestock buildings. In addition to the effects on air quality, as the size and scale of livestock facilities increases so too does the
potentially contribute to a significant contamination of ground and surface water.

**CONSTRAINTS TO MUNICIPAL INVOLVEMENT**

There is the basis for a legitimate municipal role in ensuring the appropriate establishment and siting of livestock and poultry facilities. The nature of this involvement varies across the province and reflects different attitudes towards agriculture and the livestock industry. These attitudinal differences exist between different communities and also exist between individuals within a community. These differences reflect the nature and extent of the livestock industry, the role of agriculture within the local economy, the relative presence of non-farm development, the community’s recent experience with agriculture, and the relative health of the local environment. In all probability, the ten trends outlined above will lead to an increased involvement on the part of both local and provincial authorities. There are, however, constraints on both the nature and extent of municipal involvement. Some of these are as follows:

i) **Jurisdictional Constraints**
Municipalities are established, subject to and empowered by provincial legislation. The passage of by-laws can only occur in those areas where provincial legislation establishes municipal authority. The Planning Act, Municipal Act and Building Code are the key tools and even under this legislation there are constraints in terms of the types of issues that can be addressed and the types of by-laws that can be passed. By-laws which are passed without appropriate legislative backing are subject to review and may be quashed by the courts.

ii) **Public Rights**
Related to the jurisdictional constraints which inhibit certain municipal action are the legal rights enjoyed by individuals. Included in these are the rights of farmers to challenge the legal basis for municipal action and to farm with minimal

iii) **Enforcement Issues**
Governments, whether they be local, provincial or federal have been known to pass by-laws and regulations for which they do not have the financial or human resources to implement. Any attempt to enhance the municipal role as it pertains to the siting of livestock structures needs to recognize this constraint.

iv) **Public Support**
The successful implementation of all by-laws is largely predicated on support from the public in terms of the need for, the appropriateness of and the fairness of the regulatory action. Not only is the support of the general public essential, but so too is the support of the farm community. This reiterates the need to not take action prematurely, but to work with the farm community to help develop an approach which is both understood and acceptable.

v) **Political Realities**
Local councils often reflect different perspectives of society. On occasion they reflect different interest groups and there is a need to recognize that divisive issues create certain political realities in terms of the ability of local council to effectively respond to an issue.

vi) **Protecting the Agricultural Industry and Maintaining Competitiveness**
Municipalities that have the benefit of an active agricultural industry need to recognize the need for that industry to maintain its competitiveness to compete in both the local and global market. The result is that municipalities should anticipate local change as agriculture attempts to respond to broader macro economic issues. By-laws that unduly restrict the ability of agriculture to evolve, or establish unrealistic financial impediments are likely to contribute to an unhealthy and potentially uncompetitive agricultural sector.

vii) **Comprehensive Policy Statements**
The province in March of 1995 proclaimed new legislation which established a comprehensive
within agricultural areas and the preservation of the environment. These policies, with the exception of requiring appropriate separations between livestock and non-farm uses, appear to remain relatively silent concerning the establishment of livestock facilities. What remains unclear, however, is what will be the indirect impacts on agriculture in dealing with issues related to environmental protection.

POTENTIAL APPROACHES
In many ways, issues related to the siting of livestock and poultry facilities revolve around the issue of manure management. Some of the specific issues or questions raised include:
- there needs to be an adequate and appropriate land base for the proper disposal of manure
- in some instances farmers are inadequately storing, handling and transporting manure. The result is potentially the contamination of streams and groundwater
- how should we approach livestock operations on small acreage?
- how should we handle existing problems?
- how should we respond to a situation where a farmer conveys lands he is currently using for manure disposal (perhaps resulting in an inadequate land base)?
- are livestock operations simply getting too large?
- are separation distances between farm and non-farm uses adequate?
- how should we address issues of air quality?
- what is the appropriate balance between provincial and local action?
- are we forcing small producers out of production by allowing large ones?
- the density of livestock operations is resulting in the production of manure which exceeds the capacity of the environment (land base and water) for safe assimilation

Although it is difficult to address issues of the siting of livestock and poultry operations.

1) The first of these, and potentially the most successful, is a land use planning program that respects and gives priority to agriculture within rural areas. This approach, while long-term, provides the opportunity to minimize perceptual issues. The absence of an urban concentration of population and a less dense rural population is likely to minimize the potential for conflict between farm and non-farm uses thereby minimizing the need for government regulation and involvement in agriculture. There is then the opportunity to focus on those issues that constitute a real threat to the environment and rural populations.

2) The second approach is to pursue a number of controls under the planning system.

Official Plan - Official Plans establish the land use policy or guideline for development within a municipality. Although zoning by-laws establish specific enforceable regulation, the policy of the official plan is important in terms of identifying the land use framework for zoning by-laws and for also establishing severance policy. Policy has, for example, been put in official plans stipulating that applications for severance will be reviewed to determine the appropriateness of the land base for manure disposal. In some instances the official plan may as a condition of severance require that an agreement be signed between two property owners ensuring that the manure from one property can be disposed of on someone else's property.

Agricultural Code of Practice (Guide to Agricultural Land Use) - Within Ontario, the Agricultural Code of Practice has been used over the last 20 years in conjunction with local zoning and building bylaws to require an evaluation prior to the expansion or establishment of livestock operations. This tool has focused on the identification of appropriate separation distances between livestock and non-farm uses and in this
successful. The Code also includes suggestions and recommendations concerning management practices, such as an appropriate land base for manure disposal. The Code has recently been replaced by the Guide to Agricultural Land Use and the Minimum Distance Separation (MDS) I and II (March, 1995). The Guide advises farmers on how to avoid or reduce conflicts with neighbours and environmental impacts through the use of appropriate farm practices and equipment. The Minimum Distance Separation formulas focuses on proper siting of buildings, whether for farm or non farm purposes.

**Zoning By-laws** - Zoning by-laws establish categories of land use and provide regulations that apply to each respective zone. For example, throughout rural areas agricultural zones have been established that affect the setback of livestock buildings from roads, property boundaries and lot lines. In some instances zoning by-laws have been amended to incorporate the separation distances of the Agricultural Code of Practice and in other instances by-laws have been developed to include absolute distances (example no barns permitted within 1,000 feet of a residence).

**By-laws Regulating Manure Pits** - By-laws adopted under the Municipal Act have also been used effectively to regulate the establishment of manure pits. Certain counties have developed approaches which are more encompassing in nature and include more detailed engineering and regulation than one would normally find in a zoning by-law. These restrictions for example, include setbacks from water courses, wells, and distances which vary according to the type and nature of livestock operations. In other jurisdictions certain of these types of regulation are found within zoning by-laws.

3) A third approach is to explore in further detail the appropriate relationship between the province and municipality as it relates to this issue.

Under the Planning Act there are questions concerning the extent of municipal authority in responding to many of the issues that are more specific to the management of manure. For example, there have been suggestions that municipalities regulate the size of livestock operations according to the amount of land base owned or to cap the maximum size of livestock operations. Action of this kind is likely to generate a legal challenge and needs to be clarified in consultation with provincial authorities. Moreover, the province needs to reconsider the Certificate of Compliance program that existed under the Agricultural Code of Practice (including the need for nutrient management plans), and to reevaluate the Environmental Protection Act and the Water Resources Act. The results of this provincial review may be to resolve a number of the concerns that exist at the local level.

**A RECOMMENDED APPROACH**

As reviewed above there are certain constraints to municipal action and certain opportunities in terms of available approaches. The following identifies a recommended course of action for the Township of "Don'tKnowWhatToDoAbout Pig Manure":

1) The Township has already passed a zoning by-law which incorporates the separation distance provisions of the Agricultural Code of Practice. The result has been reasonable management of the distance separations between farm and non-farm uses.

2) The Township through the official plan and zoning by-law has established land use policy which recognizes the primacy of agriculture and minimizes non-farm uses. The result is a reasonably compatible land use pattern.

3) The Township has passed a by-law under the Municipal Act regulating the establishment of manure pits.
The results are reasonable separations of land use and certain environmentally responsible regulations ensuring appropriate separation between manure storage facilities and water courses, wells, tile drainage, and non-farm uses.

4) Council should, in consultation with the public (local farmers) review the official plan, zoning by-law and manure storage by-law to identify appropriate changes. Enhanced separation distances between livestock facilities and environmental features such as wetlands should be a priority.

5) Further research is required to determine the legitimacy of some of the issues that have been identified. Is there, for example, a real problem with a farmer having an adequate land base for the disposal of manure or is the manure readily accepted by farmers who do not have livestock? We should also look at the relative location of potentially sensitive natural environment areas (such as water recharge areas) as they coincide with large livestock operations.

6) The Township should be respectful of the fact that certain issues lie outside the municipal mandate. Some issues, such as those related to land ownership (other than those which may require consent to sever) are legally and perhaps financially beyond the jurisdiction of municipalities. In areas where the municipality does not have authority, consideration may be given to lobbying provincial officials for appropriate action. Moreover, certain of the broad changes in agriculture reflect the increasing globalization and volatility of the agricultural industry and are likely to reflect both provincial and federal issues.

7) There is the need for continued dialogue with provincial officials in several key areas. Questions related to the enforcement of provincial law, the development of new approaches and the opportunity to extend the types and content of by-laws under provincial legislation should be pursued with provincial authorities. Pending the results of these discussions the municipality should seek a legal opinion concerning any further action which they might consider.

SETTING

The Same Municipal Council Meeting, Somewhere in Rural Ontario, Discussion Following the Planners Report

The planner having completed his presentation turns to the Reeve and comments:

“That concludes my formal report Mr. Reeve, I would be happy to respond to any questions.”

One of the councillors has been itching for the opportunity to begin the debate.

“One of the things you suggested” directing his comment to the planner, "was more research, meetings with the province and deferral - why don't we just get on with the issue.”

The planner attempts to respond:

“One of the things that my report didn't get into was a discussion that I had with the County solicitor over the respective role of the county and province. Referring to the Environmental Protection and Water Resources Act, he noted that farmers have an obligation to respect this legislation and where contamination or discharge into any water course occurs they are subject to prosecution. Based on the solicitors experience in defending farmers who have been charged, the Ministry is both prepared and aggressive in their enforcement of the legislation. Also, the issue of attempting to ensure that the land base required to dispose of manure remains in the ownership or control of the farmer who possesses
successful implementation will require a strong partnership between the Province, county and local municipality.

While the planner is speaking the clerk leans over and whispers to the Reeve that there is a delegation scheduled for 9:30 p.m. The Reeve sensing the conclusion of the planners comments decides to interject before the first councillor has an opportunity to continue the debate:

"If council is in agreement, I think we should ask Joe (Planner) to keep us informed of discussions with the province and also that he schedule with the clerk dates to meet to discuss our planning documents as they relate to the siting of livestock facilities."

Sensing agreement the reeve thanks the planner for his report and presentation ... and ... begins to psyche himself up for the delegation which is in attendance to discuss the municipal drain on the west side of the Township...

BIBLIOGRAPHY

Burroughs, David. 1994. And This Little Pig Went to Market. in Canadian Agriculture at a Glance. Ottawa: Published by Authority of the Minister responsible for Statistics Canada.


L’EMPLACEMENT DES EXPLOITATIONS AGRICOLES ET LE DROIT DE L’ENVIRONNEMENT: VERS UNE TENDANCE COERCITIVE?

Dr. Serge Rousselle  
U. of Moncton  
Moncton, New Brunswick

\[1\] Assistant Professor, Law School, Université de Moncton  
\[2\] Has just written two articles on agriculture and environmental law in Canada: "L'agriculture et le droit de l'environnement dans les provinces de common law au Canada" et "L'immunité de poursuites pour nuisance: le cas des exploitants agricoles"  
\[3\] Other related articles at national and int’l level

INTRODUCTION
Il va sans dire que l'agriculture est une activité humaine qui peut avoir des effets importants sur la qualité de notre environnement. Il est d'ailleurs facile de concevoir l'agriculture moderne comme une menace à l'environnement. À cet égard, on a qu’à songer aux méthodes modernes et intensives d'élevage qui « (...) peuvent avoir des répercussions sur la qualité de l'environnement et ce de diverses façons, qu'il s'agisse de la dégradation de la qualité de l'air local soumis à des odeurs désagréables ou de problèmes plus graves de pollution des eaux de surface et souterraines par suite d'une élimination inadéquate du fumier. »

Toutefois, ces menaces à l'environnement peuvent très bien ne jamais se matérialiser, tout étant fonction de l'attitude des exploitants agricoles et des pratiques agricoles employées\[2\]. Ainsi, il faut s'assurer, par exemple, que les fumiers et les déchets d'origine animale fassent l'objet d'une manutention, d'un stockage et d'un épandage anéantissant les risques de pollution potentielle de sources ponctuelles ou diffuses.

Afin que les exploitants agricoles en arrivent à de saines pratiques agricoles, les solutions gouvernementales sont diverses : d'une part, la méthode douce préconise des programmes d'éducation et de recherche et d'assistance financière et technique visant à adopter des pratiques agricoles respectueuses de l'environnement; d'autre part, la méthode forte a recours à la réglementation inflexible de normes environnementales à respecter (soit par des


Siting Livestock and Poultry Operations for the 21st Century  

90
lieux devant contenir les animaux, quant à la
manutention, l'épandage et le stockage du fumier,
quant aux distances d'éloignement entre les
bâtiments et terres agricoles et les habitations
voisinantes et les cours d'eau\textsuperscript{5}. Plusieurs
provinces émettaient des certificats de conformité
aux fermes qui respectaient ces lignes directrices et
ces certificats constituaient en quelque sorte une
forme d'évaluation environnementale de leur
rendement.

Dans plusieurs provinces, dont le Nouveau-
Brunswick, l'Ile-du-Prince-Édouard, et l'Ontario,
cette façon de faire est encore en vigueur\textsuperscript{6}.
Toutefois, d'autres provinces ont préféré, au cours
des dernières années, mettre sous forme de lois ou
règlements plusieurs des recommandations que
l'on retrouvait généralement dans les lignes
directrices comme nous allons maintenant le voir.

Ainsi, en Colombie-Britannique, le Agricultural
Waste Control Regulation, adopté en vertu du
Waste Management Act\textsuperscript{7}, prévoit qu'une personne
qui emploie des pratiques agricoles conformes à un
code de pratique joint au règlement est exemptée
des dispositions de la loi qui stipulent que nul ne
doit, dans le cours de ses affaires, permettre que
des déchets soient déversés dans l'environnement
sans permis. Le code en question (Code of
Agricultural Practice for Waste Management, April
1, 1992), qui fait donc partie du règlement, contient
une trentaine d'articles qui dictent aux fermes
d'élevage leur localisation (ex. : au moins 15 mètres
d'un cours d'eau), leur obligation

\begin{itemize}
\item \textsuperscript{3} Un peu comme si ces derniers étaient perçus
comme plus près de la nature, moins capables de polluer notre
environnement.
\item \textsuperscript{4} Ce travail ne s'attarde donc pas à la réglementation
des municipalités ayant trait au zonage et aux distances
minimales qui doivent exister entre les exploitations agricoles,
leurs voisins et les cours d'eau.
\item \textsuperscript{5} Par ex. : Lignes directrices relatives à l'utilisation des
fumiers et des déchets d'origine animale au Nouveau-Brunswick,
Guidelines for Manure Management and Separation distances
in Prince Edward Island; Ontario Agricultural Code of Practice.
\item \textsuperscript{6} Ibid.
\item \textsuperscript{7} S.B.C. 1982, c. 41.
\end{itemize}
d'entreposer adéquatement leurs déchets et leur obligation d'utiliser ces déchets dans les champs à titre d'engrais, loin des cours d'eau et en certains temps de l'année.

En Saskatchewan, on a préféré s'attarder directement aux fermes d'élevage intensif. Ainsi, il y a déjà plusieurs années que cette province exige un permis pour la construction d'installations liées aux fermes d'élevage intensif qui correspondent à une certaine définition (selon le genre et le nombre d'animaux, etc). Toutefois, la Saskatchewan vient tout juste d'adopter, ce printemps, une nouvelle loi, *An Act respecting Agricultural Operations*, qui, lorsqu'elle sera proclamée, abroge la loi actuellement en vigueur et prévoit que pour pouvoir entreposer et manutentionner les déchets d'une ferme d'élevage intensif presrite, il faut qu'un plan de gestion des déchets soit approuvé par le Ministre et que ce plan soit respecté sous peine de se voir imposer une amende pouvant atteindre 50 000 $. Le Ministre n'approuve le plan qu'à la condition, entre autres, qu'aucune pollution des eaux souterraines et de surface ne soit possible.

Au Manitoba, le *Règlement sur les déjections*

6 Malgré l'existence de ce règlement qui dictent certaines normes à suivre, le gouvernement de la Colombie-Britannique, en collaboration avec la Fédération des agriculteurs de cette province, fournit également aux exploitants agricoles des lignes directrices (par ex. : *Environmental Guidelines for Poultry Producers*; *Environmental Guidelines for Beef Producers*; *Environmental Guidelines for Dairy Producers*; *Environmental Guidelines for Greenhouse Growers*).


8 Autrefois, l'amende maximale n'était que de 5 000 $ : *ibid.* à l'art. 9.

9 Des disposition de cette nouvelle loi ont également trait au droit à l'exploitation agricole (Right to Farm) comme nous le verrons plus loin.

10 Desposition de cette nouvelle loi ont également trait au droit à l'exploitation agricole (Right to Farm) comme nous le verrons plus loin.

11 Desposition de cette nouvelle loi ont également trait au droit à l'exploitation agricole (Right to Farm) comme nous le verrons plus loin.

Au Québec, les lignes directrices ont cédé le pas à une réglementation sur le sujet en 1981. Le règlement actuellement en vigueur s'intitule *Règlement sur la prévention de la pollution des eaux par les établissements de production*.

12 Regl. du Man. 81/94


14 Regl. du Man. 93/88 R. Ce règlement prévoyait également l'enregistrement de certaines fermes d'élevage en fonction de critères prévus en annexe.

15 Ces installations doivent être à au moins 50 mètres des cours d'eau, à l'exception d'une installation de stockage en terre qui nécessite un permis pour être construite ou modifiée (un tel permis est émis ou refuser en tenant compte du type de sol, de la proximité d'aquifères et des caractéristiques du terrain).

16 De nouvelles lignes directrices complètent également ce règlement: *Practices Guidelines for Hog Producers in Manitoba*. 

92
animale\textsuperscript{17} et a été adopté en vertu de la Loi sur la qualité de l'environnement \textsuperscript{18}. Ce règlement contient plusieurs dispositions intéressantes:

- il faut obtenir un certificat d'autorisation du sous-ministre pour établir ou agrandir un établissement de production animale (et pour l'obtenir il faut respecter la Loi et le présent règlement);
- il ne doit y avoir aucun élevage sur fumier liquide à moins de 300 mètres d'une source d'eau potable ou, dans le cas d'un élevage sur fumier solide, à moins de 100 mètres d'une telle source;
- le fumier liquide doit être entreposé dans un réservoir de rétention étanche;
- les lieux d'entreposage de fumier doivent avoir une capacité minimale pour 200 jours consécutifs et doivent être protégés de sorte que les eaux de ruissellement ne puissent l'atteindre;
- l'amas de fumier solide dans un champs doit être à au moins 150 mètres d'un cours d'eau et à au moins 75 mètres d'un puits d'eau;
- l'exploitant, qu'il soit propriétaire ou locataire, doit posséder une superficie d'épandage qui lui permette de ne pas dépasser la quantité annuelle d'épandage spécifiée en annexe du règlement et ne pas épandre du fumier sur un sol gelé ou enneigé;
- il est interdit d'épandre du fumier dans l'eau ou sur le sol à moins de 30 mètres d'un cours d'eau ou d'une source d'eau potable.

Or, non satisfait de ce règlement, qui contient ce que plusieurs provinces n'ont jugé bon que d'inclure dans leurs lignes directrices, le gouvernement du Québec a fait circuler au cours de la dernière année un projet de « Règlement sur la réduction de la pollution d'origine agricole » qui remplacerait le présent règlement\textsuperscript{19}. Ce projet de règlement se veut fondé « (...) sur une approche globale et intégrée de lutte contre la pollution de l'eau, de l'air et du sol résultant des activités agricoles \textsuperscript{20} et semble encore plus précis dans sa façon de dicter aux agriculteurs de saines pratiques agricoles. Par exemple, on y précise que

- l'épandage de déjections animales n'est permis que pour fertiliser le sol cultivé en fonction d'un plan global de fertilisation intégrée (approuvé par un agronome) et selon les conditions prévues par ce plan (plan qui limite l'épandage selon la composition du sol, le climat, etc); ! l'épandage ne peut se faire entre le 1er octobre et le 31 mars de l'année suivante et qu'aucun épandage n'est permis dans les champs qui dépassent certains taux de phosphore;
- dans des zones protégées\textsuperscript{4}, à l'intérieur d'un périmètre d'urbanisation d'une municipalité, il est interdit d'ériger ou d'agrandir des bâtiments d'élevage intensif ou d'entreposage (cela est aussi interdit dans ce que le projet de règlement appelle des zones d'odeurs contrôlées), sans oublier que, de toute façon, aux endroits où de telles constructions sont permises, il faut un certificat d'autorisation.

\textsuperscript{17} L.R.Q., c. Q-2, r. 18.
\textsuperscript{18} L.R.Q., c. Q-2.
\textsuperscript{19} Gazette officielle du Québec, 24 août 1994, no. 35 à la p. 5269.
\textsuperscript{20} Ibid.
Les sanctions prévues par ce projet de règlement peuvent atteindre 25 000 $ (minimum 2 000 $) pour une première infraction par une personne physique et 100 000 $ (minimum 2 000 $) pour une première infraction par une personne morale. L'amende peut atteindre 1 000 000 $ (minimum 5 000 $) pour une personne morale lors d'une 3e infraction.

Ceci étant dit, même si d'autres provinces ont toujours des lignes directrices qui gouvernent ce domaine, il ne faut pas croire pour autant que rien ne s'y fait en terme législatif. Ainsi, plusieurs d'entre elles ont adopté des lois pour prévenir des pratiques agricoles susceptibles de constituer ce qu'il est convenu d'appeler des sources ponctuelles et diffuses de pollution de l'eau 22. Le NouveauBrunswick, par exemple, a adopté, en 1990, un décret qui limite les activités agricoles qui peuvent être exercées à moins de 75 mètres de tous les cours d'eau à l'intérieur des trente et un bassins hydrographiques de la province 23. En vertu de ce décret, aucune activité agricole n'est permise à moins de trente mètres des rives de ces cours d'eau et uniquement des activités agricoles existantes sont permises à moins de 30 à 75 mètres de ces mêmes rives, et ce dans la mesure où certaines conditions sont respectées. Or, deux des conditions à respecter nous intéressent plus particulièrement, à savoir l'obligation de clôturer les champs utilisés pour le pâturage du bétail le long de la périphérie des 30 mètres des rives des cours d'eau afin que le bétail ne puisse plus désormais s'abreuver de ces eaux et le fait que l'épandage du fumier animal soit interdit dans cette zone tampon de 75 mètres.

Une loi néo-écossaise de 1989 prévoit également la désignation de secteurs protégés dans les régions des bassins hydrographiques 24. Toutefois, le système néo-écossais est beaucoup plus décentralisé que celui du Nouveau-Brunswick: les activités réglementées varient d’un secteur protégé à l’autre. Il n’existe donc pas dans cette province une zone intermédiaire uniforme de 75 mètres, ce qui n’empêche pas certains secteurs protégés d’interdire certaines activités agricole comme en témoigne le passage suivant:

(...) the piling or accumulation of agricultural refuse or farm waste (...) is prohibited within 650 metres of the bank of the Fall Brook reservoir or within 65 metres of the bank of any lake, river, stream, pond or any other watercourse within the protected area. » 25

22 D’autres solutions ont également été adoptées. Par exemple, en Alberta, un comité conjoint industrie/gouvernement, formé en 1992, a examiné la question des fermes d’élevage intensif. Ce comité a développé un processus visant à aider les municipalités à approuver ou non les projets de construction ou d’agrandissement de fermes d’élevage intensif. Ce processus comprend une évaluation environnementale visant à identifier les problèmes de nuisance et de pollution potentielle qui pourrait découler de ces projets (on s’intéresse surtout aux distances minimale de séparation). Lorsqu’un risque sérieux de pollution existe, le projet en cause sera référé au ministère de l’Agriculture de cette province en vue de l’obtention d’une autorisation technique.

Ce nouveau processus est présentement offert aux municipalités rurales sur une base volontaire. La réglementation provinciale actuelle (Provincial Board of Health Regulations Respecting the Keeping of Livestock and PoultryDivision 23), qui est administrée par des autorités régionales de santé et qui indique l’emplacement des installations et les normes pour disposer du fumier, sera abrogée lorsque ce nouveau processus commencera à être adopté par les municipalités. N.B. Cette information provient d’une lettre du 9 mai 1995 obtenue de Tamara Hursin (Resource Planner, Alberta Agriculture, Food and Rural Development)

24 WaterAct, R.S.N.S. 1989, c. 500.
Ceci étant dit, un des gros problèmes lié aux fermes d'élevage intensif est, en particulier, la question des odeurs. Or, au cours des dix dernières années, huit des dix provinces canadiennes ont adopté ce qu’il est convenu d’appeler des lois relatives au droit à l’exploitation agricole (Right to Farm Acts). Règle générale, ces lois limitent la responsabilité des exploitants agricoles en matière de nuisance dans la mesure où ils ont recours à des pratiques agricoles normales ou généralement acceptées et se conforment aux lois sur l'environnement et l'utilisation du sol.

On pourrait ainsi croire que ces lois au lieu d'imposer des normes de plus en plus coercitives aux exploitants agricoles viennent leur en enlever, mais il faut pourtant se rappeler ici que, règle générale, les exploitants agricoles doivent continuer à respecter la réglementation environnementale pour pouvoir bénéficier de la protection accordée par ces lois relatives au droit à l'exploitation agricole. Or, il ne faut pas oublier que cette réglementation environnementale, tout en devenant de plus en plus exigente envers les exploitants de fermes d'élevage intensif, interdit, règle générale, de polluer l'air et définit le terme polluant comme s'entendant notamment d'une odeur susceptible d'avoir des effets néfastes sur l'environnement. Ainsi, l'exploitant agricole peut incommoder ses voisins, mais non polluer leur environnement, de sorte que les lois relatives au droit à l'exploitation agricole ne sont pas conçues pour protéger les activités agricoles sources de pollution.

L'exploitant agricole doit également, règle générale, se conformer à la réglementation concernant l'utilisation du sol pour pouvoir bénéficier d'une protection contre une poursuite pour nuisance en vertu de ces différentes lois provinciales. Or "(...) dans les provinces qui n'ont pas adopté de lois sur la protection du territoire agricole, force est de constater qu'exiger des exploitations agricoles qu'elles respectent la réglementation concernant l'utilisation du sol peut aller à l'encontre des objectifs des lois relatives au droit à l'exploitation agricole. En effet, au Manitoba par exemple, où une utilisation extensive non agricole du sol s'est développée en régions rurales, les exploitants agricoles sont rapidement devenus minoritaires en termes de pouvoir politique au sein de leur municipalité locale. Devant une telle situation de perte de pouvoir politique, les exploitants agricoles sont de moins en moins assurés que leur environnement rural demeurera réceptif aux activités agricoles normales et raisonnables et des restrictions de zonage pourront leur être imposées de plus en plus. D'ailleurs, ce danger est tellement réel que le Manitoba et l'Alberta ont cru bon de prévoir dans leur loi relative au droit à l'exploitation agricole une disposition selon laquelle l'immunité accordée aux exploitations agricoles en matière de nuisance est maintenue en dépit du fait qu'est


\[27\] L'Alberta ne semble pas avoir retenu cette exigence.

\[28\] Par exemple: Loi sur la protection de l'environnement, L.R.O. 1990, c. E-19, art. 1(1); Loi sur la qualité de l'environnement, L.R.Q., c. Q-2, art. 1(5); Loi sur l'assainissement de l'environnement, L.R.N.-B. 1973, c. C-6, art. 1; Environmental Protection Act, R.S.N.S. 1989, c. 150, art. 3c); Loi sur l'environnement, L.M. 1987-88, c. 26, art. 2.
modifié le règlement régissant l'utilisation du sol et que l'exploitation agricole devient une utilisation non conforme. Il va sans dire que de telles dispositions seraient incongrues si les provinces en cause avaient un bon système de protection des terres agricoles.  

CONCLUSION

Nous avons donc pu nous rendre compte que les interventions étatiques visent de plus en plus à dicter aux exploitants agricoles des pratiques environnementalement saines en utilisant l'exemple des fermes d'élevage intensif au pays. Cela reflète un changement d'attitudes, puisqu'on ne se contente plus seulement de donner à l'exploitant agricole l'information qui pourra le guider vers des pratiques plus saines, on lui impose de plus en plus des façons de faire. Ainsi, une nouvelle éthique environnementale, selon laquelle l'agriculteur n'est plus perçu comme garant de notre environnement, laisse de moins en moins à l'agriculteur le soin de respecter l'environnement sans intervention étatique coercitive.

À ce sujet, la sagesse populaire nous apprend qu'il faut toujours regarder d'où on vient pour savoir où on va. Ainsi, si le chemin parcouru au cours des dernières années en matière de réglementation environnementale relative aux fermes d'élevage reflète fidèlement cet adage, il est possible de prévoir qu'au cours des prochaines années les fermes d'élevage intensif seront de plus en plus sujets à une réglementation formelle et coercitive en matière d'environnement.

29 Rousselle, supra note 26. Ce problème de taille d'utilisation du sol affecte évidemment et les exploitants agricoles et leurs voisins. Lorsqu'on sait, par exemple, que dans une province comme le Nouveau-Brunswick il n'existe pas d'autorités locales dans la majeure partie du secteur rural, il est facile de concevoir qu'on y trouve de tout (exploitations agricoles, forestières, minières et touristiques, développements résidentiels, commerciaux et industriels) et, à cet égard, pour une cohabitation pacifique de tous et chacune, une loi relative au droit à l'exploitation agricole n'a de sens que si elle est conjuguée à une réglementation efficace concernant l'utilisation du sol.

However, Agriculture is coming under increasing scrutiny by non-farm interests in Canada in terms of its environmental performance.

The sector is, nevertheless, regarded as more sustainable, in environmental terms, than energy, fisheries and forestry. We want to ensure that we keep it that way.

The overriding public environmental concern with agriculture is chemical use. Water use ranks a distant second on a national basis but we know that the risk of surface and ground water contamination is a constraint to the expansion of livestock operations at local levels.

This concern, together with the odour issue, has become a major challenge for producers in terms of where they can locate or expand. Indeed, within the agricultural sector, in my view, water quality has replaced soil conservation as the key resource issue for the future.
The challenge for you as producers is to identify future pressures and sectoral vulnerabilities early enough to be able to take the necessary action before environmental issues become serious limitations to productivity and growth.

To negotiate successfully with non-farm Canadians and pressure groups, in order to get realistic solutions on agri-environmental issues, the agri-food sector will need to take a proactive approach and demonstrate due diligence. Pollution prevention and conservation of resources is a cheaper and more publically acceptable approach than remedial action.

MEETING THE CHALLENGE

I am very encouraged by the recently proven successes by farm organizations in BC who have successfully negotiated Waste Management Plans and Regulations and a Code of Practice within the Waste Management Act and Ontario's Environmental Farm Planning initiative where effective coalitions have lead and delivered environmental policy and programs.

My staff and I are working with the Canadian Pork Council to develop an environmental action plan.

The CPC recognizes that public perceptions of the environmental impacts of pork production are increasingly acting as a constraint to the industry's ability to increase production in response to market opportunities.

Concerns about the risk of ground and surface water contamination in certain watersheds, notably in the Eastern Townships of Quebec and the Interlake Region of Manitoba, are resulting in the introduction of moratoria on the size of existing operations and zoning restrictions on the location of new operations.

The CPC Board of Directors decided a year ago in Halifax to develop an environmental action plan which would include a national code of practice for pork producers. This code would consist of a set of guidelines for waste handling practices which would assure regulatory authorities (including municipalities), lending institutions and concerned non-farm interest groups that pork producers are prepared to operate in a proactive, environmentally responsible manner.

The intent is that under the action plan, both municipalities and the industry would rely on the code, rather than on regulations, to develop mutually acceptable practices for the use, storage and management of swine manure.

A 13 member committee, called the Canadian Pork Council Environmental Resource Group, was formed in early 1995. I am pleased that two members are from my department, from the Environment Bureau and the Centre for Food and Animal Research, respectively. Producer associations, provinces, academia and lending institutions are also represented.

The committee has completed a preliminary Code for Environmental Standards for the Canadian Pork Industry. I won't go into detail since the code is not expected to be finalized until the fall.

Guidelines are being drafted for the storage and use of agricultural wastes, land application practices, control of air emissions, on farm disposal of mortalities, swine access to water, and the use and storage of agricultural products (e.g., feeds, chemical fertilizers).

This comprehensive, proactive approach bodes well for the pork industry in its efforts to reduce environmental barriers to expansion and illustrates its commitment to dealing with the environmental impacts of pork production.
The importance of having a credible game plan in place to deal with expansion can be illustrated by the competition for a major hog slaughter plant that western Canada is now engaged in with our neighbours south of the border.

It would not be the first time that a Canadian interest had done all the right logistical, financial and economic homework to win over investors to their community for a major plant and then lose the battle because vocal and influential environmental interests raised enough concern to kill it.

We need to demonstrate that we have done our environmental homework as well and clearly illustrate that enough environmental safeguards have been established for a plant in Manitoba or Saskatchewan that it will bearup to the inevitable environmental scrutiny such plans will be subjected to.

The CPC environmental action plan is one example of an effective industry response to environmental pressures, in partnership with the federal and provincial governments. Government can assist the sector in other ways: by providing the tools and sending the right signals through our policies and programs and in the management of our own operations. So let me turn, for a moment, to the Challenge to Government.

**CHALLENGE TO GOVERNMENT**

Less than three weeks ago, on June 28th, the federal government announced its sustainable development framework entitled "A Guide to Green Government". Under this comprehensive framework each federal department is required to prepare and implement its own sustainable development strategy over the next two years. Each departmental strategy must have the following three elements:

- economic and environmental integration;
- results-oriented, measurable and time-bound goals and targets; and
- use, where applicable, of new policy instruments to deal with environmental problems.

It also stresses the fundamental importance of pollution prevention. But what is environment-economy integration?

Essentially it is the inclusion of environment considerations into decision-making, both at the operational level and in the development of new policies, programs, laws and regulations. It will no longer be sufficient to assess only the economic or social benefits or costs to the sector of a new policy or program; measures to prevent or at least mitigate depletion or degradation of the natural resource base must be incorporated in the basic analysis and the design. This approach is part and parcel of the principle of sustainable development which couples economic viability with environmental sustainability. Progress in achieving this integration will be reported annually by each Department to Parliament and assessed by a Commissioner of the Environment and Sustainable Development.

Environment-economy integration requires that all sectors of the economy become more self-reliant and accountable for their environmental performance.

Work is underway in AAFC to ensure that we can meet the other two requirements for a sustainable development strategy: results-oriented, time-bound measurable goals and targets, and secondly, scope for use of a broad range of policy instruments.

The Agri-Environmental Indicators Project is developing scientifically sound measures of current conditions and trends that will provide a better understanding of environmental risks and enable the sector to better defend itself against unsubstantiated environmental
criticisms. Such information will also enable the
government, in consultation with stakeholders, to
target strategies and actions more effectively in
areas that would benefit most.

In regard to use of policy instruments, AAFC must
consider the full range of instruments available to
achieve overall objectives such as
environmentally sound management practices on
farms. The reality is that we can no longer afford
the traditional approach of subsidizing the
adoption of best management practices.
Economic instruments such as tradeable manure
rights have been used in other countries, and
cannot be totally ruled out. In Canada users
including many farmers of methyl bromide, a
fumigant used mainly in agriculture, have agreed
to use tradeable permits to freeze consumption to
1991 levels this year and achieve a further 25%
reduction by 1998.

Regulation will no doubt continue to be important,
and may get broader in some cases as
expanding populations and economic activity put
more pressure on competing uses of resources.
But the answer is continuing voluntary progress,
building environmental considerations into the
overall management of your operations. It's not an
add on. It's not a choice anymore. Future
expansion depends upon a number of factors with
the environment becoming more and more critical.
Investing in the environmental management of an
operation is just good business sense.

CONCLUSION

Both the department and the sector face
challenging environmental agendas. Increased
public awareness of agri-environmental issues
presents both challenges and opportunities for
livestock and poultry producers. Collaborative
efforts between government, producers and non-
farm interests can be successful, as demonstrated
by the CPC environmental action plan.

I noted at the beginning of my presentation that I
am impressed by the cross-section of interests
that are present at this workshop. It is in
gatherings such as this that the collaborative
process begins, with the dissemination of
knowledge and the exchange of views.
ADVANCES IN NUTRITION: EFFECTS ON SITING ANIMAL AGRICULTURE

Dr. Al Fredeen
Nova Scotia Agricultural College
Truro, Nova Scotia

Chair, NSAC Graduate Studies Committee
Eastern Director, Can. Soc. of Animal Science
Expert Committee Animal Nutrition
Areas of research include rumen-protected amino acids for dairy cows, macro-mineral metabolism in ruminants and dairy farm systems

Co-author: R. Loucks, Environmental Consultant, Halifax, N.S.

ABSTRACT

The relation of animal nutrition to the siting of animal agriculture is through its impact on nutrient and energy flows in the agro-ecosystem and subsequent effect on the environment. The focus of this paper is on technologies that exist for improving the efficiency of utilization of nutrients and energy by the animal. We speculate on opportunities that might tie some types of food-animal production closer to the consumer, as opposed to the current trend of increasing separation. The discipline of animal nutrition has dealt with identifying and quantifying nutrient and energy requirements for optimal animal performance and improving the efficiency of animal production. Losses of nutrient in the excreta due to incomplete digestion, absorption and metabolism can be reduced by employing nutritional technologies, particularly those that permit reductions in the off-farm inputs of N and P. Since conservation of nutrients and energy is also central to the issue of sustainability of animal agriculture, the discipline of nutrition must evolve to concern itself with nutrient and energy flows in the agro-ecosystem and with closing nutrient cycles in systems involving the consumer. Closing nutrient flows by involving the consumers in the system, would also link animal production physically with centres of human population. Consequently the source of nutrients, as well as the employment of technologies that improve the use of nutrients, have important effects on the overall efficiency and siting of farm animal production. Utilization of nutrition technologies alone can not achieve the level of efficiency of nutrient use that is needed to broaden siting opportunities for animal agriculture. For long-term sustainability, all losses must be reduced through tightening nutrient cycles.

INTRODUCTION

Constraints on the siting of animal agriculture in the future will likely revolve around the amount and source of nutrients and energy used on farm. We predict that in 2005, restrictions on fuel use will contribute to escalating transportation costs, legislation will place strict limits on agricultural use of N, P, emissions of pathogens, NO₃, odour and perhaps, indirectly, energy (e.g. through required

pasturing of ruminants). In urban centres, a stewardship philosophy will be propagated: individuals will be more responsible for their use of resources and for wastes they create. Urban waste streams will be shrunk and odour free. The same demands will be placed on farms.

Large scale separation of urban wastes into streams will create feed resources for animal agriculture. For example, in Halifax county, NS, approximately 1 kg food wastes capita\(^{-1}\) (as fed basis) are currently generated. In addition, humans are inefficient users of nutrients they consume, and the diets of North Americans are loaded with nutrients in excess of their requirements. Humans excrete, on average, 10 g P\(_{04}\) and 25 g N daily (Thomann 1972). When the byproducts arising from the preparation, digestion and metabolism of food are also recycled, rather than disposed of as wastes, and people are made responsible for the true cost of disposal of the byproducts they generate, agricultural use of these nutrients will be a natural and desirable goal. Use of compost toilets, for example, will create a usable source of nutrients for the urban landscape and agricultural soils. Crops with high nutrient requirements are the most likely candidates for these nutrients, and their production would need to be close to the source of this nutrient because of transportation costs and because this is where prime agricultural soil is often situated. These crops would include high biomass non-leguminous crops for the provision of feed and bedding for farm animals and C for composting, as well as high energy crops such as corn and other cereals. Consequently, crop production and animals associated with consuming the byproducts would need to be located near urban centres where the byproducts are generated.

From a nutrition perspective, the major consequences of animal agriculture that would affect where it is located, are its requirement for energy and its contribution to the pollution of water and air. Factors linking it to urban centres include its ability to use urban and industrial waste and increasing costs of transportation for moving products, feed and fertilizer. Opportunities are created in these key areas for the development and employment of nutrition technologies. The topic of animal production and pollution has been reviewed previously (Cole 1991; Williams and Kelly 1994).

**WATER POLLUTION**

Animals are imperfect convertors of feed nutrients and energy. Undigested feed residues and end products of catabolism of surplus absorbed nutrients are excreted. Excreted nutrient is potentially captured in the manure and cycled back to the crops and animals, but these nutrients also represent potential pollutants if they are not effectively captured, stored and returned. The nutrients that are of most concern because of cost, availability or pollution potential are usually N and P. Legislation in some countries currently limits the application rate of manure on land in vulnerable agricultural zones, defined as land that drains water containing more than 50 mg L\(^{-1}\) N\(_{03}\) (Schutte, 1994). Legislation exists or is pending in North America. With farms now being considered point sources of pollution, amount and efficiency of nutrient utilization by the animal are important concerns regarding siting.

Farm animals have obligatory maintenance nutrient and energy costs that are typically minimized by reducing periods of low or nonproductivity in the animal's life cycle. Consequently, the proportion of inputs captured in the products of growth, reproduction and lactation in agro-ecosystems is higher than that in natural ecosystems. Nutritionists have concentrated on mechanisms for reducing the digestive and metabolic losses of nutrients within the context of maximizing animal productivity. Two options exist for reducing the amount of waste nutrient at the animal level: either reduction or increase in use of off-farm nutrient inputs.

**OPTION 1 - REDUCED NUTRIENT INPUTS** Reducing nutrient inputs suggests either a
Adjusting nutrient inputs to match requirements - Life-cycle feeding of nutrients requires a good understanding of the nutrient requirements of animals and accurate characterization of the ability of feeds to provide the nutrients. The Cornell Net Carbohydrate Protein System (CNCPS) is an example of a semi-mechanistic ration balancing programme that attempts to integrate the digestive and metabolic activities in ruminants. Using this approach reduces nutrient waste by minimizing periods of over- and under-supply of nutrients in the diet, and by achieving a synchronous balance among nutrients that compete with or require each other's presence for optimal utilization (see Table 1).

<table>
<thead>
<tr>
<th>Phase of life cycle</th>
<th>Potential Reduction in N Excretion, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate pregnancy and lactation</td>
<td>10</td>
</tr>
<tr>
<td>diets</td>
<td></td>
</tr>
<tr>
<td>Growth phase</td>
<td>2</td>
</tr>
<tr>
<td>- different grower/finisher diets</td>
<td></td>
</tr>
<tr>
<td>- multi-phase</td>
<td>10 - 20</td>
</tr>
</tbody>
</table>

Refining inputs - Conversion efficiency of dietary N is improved if dietary protein is ideal i.e. balanced in amino acid (AA) composition and similar in makeup to the protein that is to be synthesized. Also, less dietary N is need to meet AA requirements. Consequently, maximal efficiency of N use can probably be achieved using synthetic essential AA (EAA) to supplement dietary proteins.
Using ‘ideal’ proteins, therefore, these values approach

<table>
<thead>
<tr>
<th>Item</th>
<th>NRC</th>
<th>NRC+UIP</th>
<th>Low CP</th>
<th>Low CP+RPAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP, % req’t</td>
<td>98</td>
<td>110</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>Met, % req’t</td>
<td>100</td>
<td>110</td>
<td>100</td>
<td>110</td>
</tr>
<tr>
<td>Lys, % req’t</td>
<td>90</td>
<td>110</td>
<td>80</td>
<td>110</td>
</tr>
<tr>
<td>Met:MP</td>
<td>2.07</td>
<td>2.05</td>
<td>2.12</td>
<td>2.30</td>
</tr>
<tr>
<td>Lys:MP</td>
<td>5.77</td>
<td>6.14</td>
<td>5.77</td>
<td>6.92</td>
</tr>
<tr>
<td>Met:Lys</td>
<td>2.79</td>
<td>3.00</td>
<td>2.72</td>
<td>3.01</td>
</tr>
</tbody>
</table>

Predicted animal performance:

<table>
<thead>
<tr>
<th>Item</th>
<th>NRC</th>
<th>NRC+UIP</th>
<th>Low CP</th>
<th>Low CP+RPAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI, kg d⁻¹</td>
<td>20.6</td>
<td>20.5</td>
<td>20.8</td>
<td>20.0</td>
</tr>
<tr>
<td>Milk yield, kg d⁻¹</td>
<td>32.3</td>
<td>32.7</td>
<td>31.9</td>
<td>31.8</td>
</tr>
<tr>
<td>Milk protein, g kg⁻¹</td>
<td>30.8</td>
<td>30.8</td>
<td>30.2</td>
<td>30.9</td>
</tr>
</tbody>
</table>

Predicted N balance:

<table>
<thead>
<tr>
<th>Item</th>
<th>NRC</th>
<th>NRC+UIP</th>
<th>Low CP</th>
<th>Low CP+RPAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>N intake, g d⁻¹</td>
<td>544</td>
<td>597</td>
<td>520</td>
<td>497</td>
</tr>
<tr>
<td>Milk N, g d⁻¹</td>
<td>157</td>
<td>158</td>
<td>151</td>
<td>156</td>
</tr>
<tr>
<td>Manure N, g d⁻¹</td>
<td>387</td>
<td>439</td>
<td>369</td>
<td>341</td>
</tr>
</tbody>
</table>

Efficiency of

<table>
<thead>
<tr>
<th>Item</th>
<th>NRC</th>
<th>NRC+UIP</th>
<th>Low CP</th>
<th>Low CP+RPAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>N use, %</td>
<td>29</td>
<td>26</td>
<td>29</td>
<td>31</td>
</tr>
<tr>
<td>Reduction in N excretion relative to NRC, g d⁻¹</td>
<td>-</td>
<td>+57</td>
<td>-18</td>
<td>-41</td>
</tr>
</tbody>
</table>


Table 3. Effect of synthetic amino acids on the efficiency of N utilization and reduction in N excretion in animal production

<table>
<thead>
<tr>
<th>Item</th>
<th>Efficiency of N use</th>
<th>Reduction in N excretion</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poultry, eggs or meat</td>
<td>40</td>
<td>15-20%</td>
<td>Schutte, 1994</td>
</tr>
<tr>
<td>Dairy cows, milk</td>
<td>23-33</td>
<td>25%</td>
<td>Robinson et al., 1995</td>
</tr>
<tr>
<td>Swine</td>
<td>-10 kg pigs</td>
<td>10-20</td>
<td>Jacob, 1995</td>
</tr>
<tr>
<td></td>
<td>74-80²</td>
<td></td>
<td>Chung and Baker, 1992</td>
</tr>
</tbody>
</table>

² Using ‘ideal’ proteins, therefore, these values approach
Little research has been done to examine the potential impact on N excretion. However, an example using the CNCPS illustrates how N excretion is potentially reduced, and N capture in the form of high quality milk protein enhanced, by the strategic feeding of rumen-protected (RP) AA to dairy cows (Table 2).

Table 3 shows the typical ranges in efficiency of N utilization and reductions in N excretion that can be expected by the strategic use of AA in animal diets.

Efficiency of N utilization in ruminants may be lower than that of monogastrics, because many AA are degraded in the rumen. However there is greater potential to utilize NPN in ruminants, thus enabling them to make use of human inedible resources. In ruminants, characterising and balancing the digestible carbohydrate fractions (sugar, starch, fiber), and N fractions (soluble, degradable and rumen-escape fractions) can be used to maximize microbial protein yields and reduce total N supply.

In some instances, chemical form of minerals can also be used to improve the efficiency of their utilization and reduce the potential for environmental pollution. For examples, chelated Cu may be less susceptible to the formation of insoluble complexes in the rumen, resulting in improved absorption (Du et al. 1995) and Se from seleno-yeast may be absorbed more efficiently in ruminants than sodium selenite (Fisher 1995).

**Altering animal utilization of nutrients** - Enhancing conversion of feed to a useful product (Table 4) reduces the number of animals required to produce the product and losses of nutrient. Although manipulation of digestion is both easier to achieve and generally more acceptable to society (excluding genetic selection perhaps), a number of approaches have been researched to alter metabolism of nutrients. These include: use of feed additives that alter microbial end products (e.g. ionophores for ruminants), injectable metabolic modifiers (e.g. recombinant porcine genetic engineering of animals (e.g. to improve leanness and productivity) or microbes (e.g. for synthesis of more balanced protein), immunization (e.g. against adipocytes or ST-releasing inhibiting factor), or altering sex ratios in offspring.

**Disease Prevention** - Disease diminishes animal performance and reduces efficiency of nutrient use. Relationships between nutrition and disease are both direct and via its impact on immunity. Nutrition will become an increasingly important method of preventing illness. Several nutritional agents have been shown to be effective immunostimulants including polysaccharides and immunoreactive peptides (Macdonald 1995). Trace minerals (notably Cu, Fe, Zn and Se) and vitamins also play important roles in disease prevention.

**OPTION 2 - INCREASE NUTRIENT INPUTS**
Increasing the amount of nutrient input to animals could be used to maximize animal production. By requiring fewer animals to produce the amount of desired product, the maintenance nutrient cost associated with more animals is saved, and size of nutrient flows is reduced. Possible mechanisms are discussed below.

**Reduce inputs of off-farm soil amendments/maximize nutrient input to animal** - Maximizing the amount of nutrients fed to animals in their diets may be more efficient than applying the nutrient to the soil directly in the form of fertilizer. Use of nutrient by the animal results in diminishing returns and lower efficiency of nutrient capture. Therefore, this approach would need to be combined with efficient methods for capture of the byproduct nutrient and for its application to the soil as animal manure. Metabolism of excess nutrients (e.g. N) can result in impaired reproduction, higher use of metabolizable energy, and undesirable interactions, consequently certain upper limits on nutrients would need to be imposed.
Increased animal productivity - The most common argument in favour of high input animal agriculture is that less land, fewer animals, and fewer farms are needed to produce food. Conversely, the reaction of farmers to mechanisms for achieving higher animal productivity could be higher animal concentration and production of more product for export. Genetic improvement of animals focusing on production, in combination with the use of production enhancers such as recombinant bovine ST (rbST) for lactating cows are two biotechnologies that could result in reduced number or density of animals and reduced nutrient loss overall without changing output. However, if farm output is increased in response to higher productivity per animal, increasing productivity of animals without reducing the inputs would result in a more concentrated group of higher producing animals and overall higher loss of nutrients from the farm (Table 5). This approach has led to problems with siting that have been encountered in the past.

### Table 4. Potential effect of biotechnologies on feed efficiency and carcass fat in growing animals

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>F:G</th>
<th>Carcass fat</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunization against adipocyte (swine)</td>
<td></td>
<td>10-20</td>
<td>Flint 1992</td>
</tr>
<tr>
<td>Injection of pST (swine)</td>
<td>4-32</td>
<td>18-68</td>
<td>Etherton 1994</td>
</tr>
<tr>
<td>Feeding ionophores (beef)</td>
<td>5-15</td>
<td></td>
<td>Bergen &amp; Bates 1984</td>
</tr>
</tbody>
</table>

**AIR POLLUTION**

Air pollution (odour) is probably the main factor affecting siting of animal agriculture in Canada. Odour results from a complex and variable emission from the manure. Odour control is effectively dealt with through manure management and less intensive agriculture, however, nutritional biotechnologies have been developed in response to the problem. They include use of dietary enzymes, chemicals and microbial products. For example, reduction in the emission of ammonia from poultry and hog manures has reduced consumer complaints during lagoon emptying and manure spreading (Lyons 1995).
Table 5. Potential effect of higher milk production on N excretion where animal concentration on farm or farm output of milk is held constant

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Approx. Percentage Change in 1 Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Milk DMI N excretion</td>
</tr>
<tr>
<td></td>
<td># cows constant</td>
</tr>
<tr>
<td>Genetic improvement</td>
<td>1.5 1.5 1.0 -2.0</td>
</tr>
<tr>
<td>Injection of rbST</td>
<td>4.5 4.5 4.5 -5.0</td>
</tr>
<tr>
<td>Both</td>
<td>6.0 6.0 5.5 -7.0</td>
</tr>
</tbody>
</table>

Assumptions: rbST injected into 75% of herd for 6 mos of year increases milk yield by 1.5 kg daily over 12 month period in herd averaging 30 kg/cow/12 mos (intake increases by 1 kg/d). Genetic improvement but not rbST improves efficiency of N use. Approx. 4.5 % fewer cows required by using rbST; 1.5 % fewer cows needed due to genetic improvement, rearing and maintenance N costs of extra cows are saved in addition to feeding them during lactation.

Note: Genetic increases are annual, whereas increases due to rbST are not.

THE ENERGY CRUNCH

The energy requirement of a farm could affect its location. Animal production systems that are highly dependent on off-farm sources of energy are not sustainable and will not exist in the long-term unless cheap renewable sources of energy are found, or society is willing to subsidize agricultural energy use. Competition between animals and humans for resources may create opportunities for production of monogastric animals in the role of scavenger e.g. hogs fed food wastes, and ruminant animals as convertors of range, crop residues and rotation crops. In this scenario, monogastric production would, therefore, be sited close to the centres of human population and food processing; ruminants would be located in the hinterlands and in association with the generation of crop residues.

CASE STUDY

Efficiency of nutrient utilization is a key factor affecting siting of animal agriculture. Consequently, a system modelling approach was used to examine the relative benefits of employing nutritional technologies, versus tightening nutrient cycles, on the efficiency of nutrient utilization as measured by the requirement for new (import) N and P in the system. The purpose was simply to compare the potential magnitude of benefits derived from the two approaches that may influence siting opportunities as affected by nutrient flows. Stella II (High Performance Systems Inc., Hanover NH) was used to model the N (Figure 1) and P (Figure 2) flows in a system that included a human population of one million and the animal agro-ecosystem necessary to supply 50 % of its need for N and 33 % of its need for P.
losses of nutrient from animal manure were 70% decreasing to 50% for N and 70 decreasing to 30% for P. Reductions were derived by employing conservation mechanisms;

one half of N (0.125 kg d⁻¹) and 33% of P (0.01 kg d⁻¹) input to humans was derived from animal product and all of this nutrient was excreted; thus required input = output (Thomann 1972);

nutrients derived from plants by humans were not included;

initial efficiency of nutrient utilization by animals was 20% for N, increasing to 30 (a factor of 50%) by employing nutritional technologies, and 40% for P, increasing to 50% (a factor of 25%), by employing nutritional technologies.

Figure 3a shows the hypothetical effects of employing nutritional technologies (on day 15) and improving nutrient cycling (on day 30) on N flows (kg d⁻¹) in: feed, manure, animal product and imports to the farm. Nitrogen flows in product were fixed at the level of human consumption. Employing nutrition technologies reduced feed N, manure N excretion and import N. Employing better conservation and recycling resulted only in a reduction in imported N required.

Figure 3b shows the hypothetical effects of improving efficiency of N use on N use efficiency ratios. Nutrition technologies reduced the amount of imported N per unit of product N only, whereas improved capture and recycling of byproduct N also reduced the amount of imported N per unit of feed N. Improving efficiency of N utilization by the animal and improving nutrient cycling are needed to reduce losses to the environment and improve siting opportunities for animal agriculture. Greater improvements in efficiency than those observed are needed to eliminate imported N and become totally self-sufficient.

Assumptions for the model were:

losses of nutrient from human use of the animal products due to leaching, volatilization, dumping etc. were 90 decreasing to 50% for N and 90 decreasing to 30% for P. Reductions were derived by employing conservation mechanisms;
Figure 3a. Predicted N flows to product (1), feed (2), manure (3) and the amount of imported N required to replace that which is lost (4). On day 15, nutritional technologies are employed to increase the efficiency of N utilization by the animal by 50%. On day 30, nutrient losses from human use and animal manure are reduced from 90 to 50, and 70 to 50% respectively.

Figure 3b. Predicted efficiency ratios of imported N: feed N (1), and imported N: product N (2), based on N flows shown in Figure 3a.

Figure 4a. Predicted P flows to product (1), feed (2) and manure (3) and the amount of imported P required to replace that which is lost (4). At day 15, nutritional technologies are employed to increase the efficiency of P utilization by the animal by 25%. At day 30, nutrient losses from human use and animal manure are reduced from 90 to 30, and 70 to 30% respectively.

Figure 4b. Predicted efficiency ratios of imported P: feed P(1) and imported P: product P(2), based on P flows.

**MAJOR CONCERNS/NEEDS**

Society must recognize the need to manage nutrient and energy flows with the goal of attaining greater sustainability. Greater sustainability enhances coexistence of farms and urban populations since improved efficiency of nutrient use reduces the potential impact on the environment. An energy crisis will modify the niche of animals in agriculture and the type of farm system used. Most of the siting conflicts with society arising from animal agriculture (water and air pollution) stem from its intensification. The nutritionist plays an important role in employing
technologies acceptable to society that improve efficiency of nutrient use. A list of nutrition topics currently being researched that may create opportunities for siting of animal agriculture includes:

1. development of cost-effective mechanisms for degrading lignin in forages and roughages to reduce feed inputs/ improve productivity of ruminant production systems;

2. development of improved dietary enzymes for monogastrics to increase the availability of P and oligosaccharides;

3. identification and development of nutritional regulators of metabolism that can improve the efficiency of nutrient use;

4. development of effective nutritional mechanisms for enhancing animal immunity;

5. determining the dietary characteristics required to achieve maximal production of rumen microbial protein in ruminants fed forages and byproducts;

6. development of highly productive pasture systems for dairy cows;

7. improved characterization of the requirements, particularly EAA, of animals during their life cycles and mechanisms for their delivery;

8. development of feeding systems for utilization of byproducts in monogastric animal systems;

9. development of safe and effective vaccines to modulate animal growth and partition of nutrients;

10. development of safe and effective means of manipulating sex ratios in offspring and effecting twinning in cattle;

11. genetic improvement of animals to achieve higher efficiency of nutrient use and higher yield and quality of product;

**PROGNOSIS**

Nutrient wastage creates the potential for pollution and is not sustainable. As the need arises to utilize nutrients more efficiently because of legislation, or economics, part of the solution may be found in employing technologies at the animal level to improve efficiency of nutrient use. Nutritionists must consider nutrient and energy flows in systems involving the animal and the consumer to reduce limitations on and improve opportunities for siting

**REFERENCES**


EMERGING ENGINEERING TECHNOLOGIES RELATING TO THE SITING OF LARGE-SCALE PRODUCTION FACILITIES

Dr. Jerry Leonard
University of Alberta
Edmonton, Alberta

! U of Southern Queensland, Australia, Agricultural Engineering to 1977
! Current research and teaching interests include development of systems for the mgt. of wastes in the bioresource industries, with emphasis on composting and related impacts on soil and air

Co-author: J.J. Feddes, Department of Agriculture Food and Nutritional Sciences, University of Alberta, Edmonton, Canada

INTRODUCTION

The siting of large scale animal production facilities involves the consideration of numerous factors which can be roughly grouped into economic and environmental categories. Economic factors include the proximity to feed and other inputs, proximity to processors and markets, proximity to transportation and other services, and the cost of land and materials. Environmental factors on the other hand include suitable topography and drainage, direction of prevailing winds, availability of a sufficient and suitable land base, and the potential of the proposed enterprise to constitute a nuisance or to cause damage to the environment.

Recent trends have seen these economic and environmental factors increasingly coming into conflict. On the economic side, political and trade developments have combined to encourage the development of increasingly larger production units. While these result in economies of scale, they also have the effect of concentrating environmental effects and potential problems.

On the environmental side, there has been a parallel development in our society of increased awareness and decreased tolerance of environmental threat or abuse. The net result of the two trends is a situation in which designers of production facilities must have unprecedented sensitivity toward environmental factors and must be prepared to utilize all the technological tools that are available to ensure that facilities meet the full range of economic and environmental criteria.

In determining suitable sites for large-scale animal production facilities, the engineering technologies that are likely to be of most relevance are those relating to the prevention of odour and pollution. If odours are eliminated or controlled, the separation distance of a facility from neighbours can be minimized, thereby giving increased siting options. Similarly, if ‘waste’ products can be managed on site so that their impact on the surrounding environment is minimal, conflicts can be avoided and any site approval processes can be streamlined.

Hence, the focus of this paper is on emerging engineering technologies for odour and manure management in large-scale, intensive animal production facilities. The aim of the paper is to provide a broad overview of current approaches and research in these areas and to attempt to define the applicability of these approaches to the Canadian situation. As a starting point, "traditional" technology is outlined together with its strengths and weaknesses. This is followed by sections dealing with odour management technologies and various emerging options for manure management.

TRADITIONAL SYSTEMS

Any attempt to define the state of the art in manure management is likely to be confounded by the variety of systems in use for enterprises of different types and sizes. Although somewhat dated, the Canada Animal Manure Management Guide (Agriculture Canada 1979) provides a good overview of current practice but, for the purposes of this paper, two basic systems will be considered: one for handling manure as a solid or semi-solid and one for liquid handling.

Manure is often handled as a semi-solid in poultry operations, in beef feedlots and increasingly in dairy housing. In all cases the material is usually stockpiled before being spread on the land and incorporated. If the piles and spreading are well-managed this method can be both efficient and cost effective. However, some of the problems that can arise are as follows:

- Uncontrolled leachate or runoff from piles can cause pollution of surface and ground water.
- Anaerobic decomposition within the piles can give rise to odour problems.
- Piles can become sites for fly infestation.
- The physical characteristics of the manure can make it difficult to spread uniformly. In extreme cases this can lead to areas of toxicity or leaching of nutrients into groundwater.

Even where manure is handled primarily as a solid or semi-solid, there is likely to be a need for managing liquid that is collected as runoff or leachate from piles. Currently, systems for doing this are very similar to those for handling manure as a liquid or slurry.

Although there are numerous options available for handling manure as a liquid or slurry, the simplest and probably most common is simply to store the liquid in a tank or pond before irrigating, spreading or injecting it into the soil. Even in cases where the manure storage is intended to promote aerobic decomposition of the manure, most liquid manure storages function anaerobically, at least in part. At the very least this gives rise to objectionable odours, particularly when the manure is agitated or taken from the storage for land application. In the worst-case scenario, anaerobic activity can result in the presence of toxic gases in lethal concentrations.

Although the above has tended to accentuate the potential negative aspects of current manure management systems, there is no doubt that such systems, when properly designed and managed, can perform quite satisfactorily - particularly in small to moderate-sized installations. Nevertheless, societal and economic pressures are dictating that new approaches should be explored.
to address the shortcomings of existing systems and to allow for increases in the magnitude of planned new enterprises.

EMERGING SYSTEMS
ODOUR MANAGEMENT

Odour is the most obvious and emotion-filled point of conflict between intensive animal producers and their neighbours. Consequently, it is accorded central importance in current siting guidelines (ILOC, 1995) and often is the governing factor in deciding on the location of a production unit. If odour control could be improved, conflicts could be avoided, existing enterprises would find it easier to expand and new enterprises would find it easier to locate in closer proximity to centres supplying transportation, labour and other services.

Some technologies of relevance to odour control that have been explored recently or are in the process of being applied are as follows:

**Storage covers** - One way to limit odours is to contain them at source or to prevent them being carried to receptors downwind of the source. Methods of doing this vary from enclosing the entire manure storage to covering the surface of the storage with barriers of varying permeability. Structurally enclosing the entire storage is obviously an expensive option and would only be contemplated in extreme cases. Cheaper options that have been used successfully include the use of spaghnum peat (Daigle et al. 1987; Barrington et al. 1990) and straw (PAMI 1993) spread on the surface of the storage. Oldenburg (1989) tested a number of supported and floating covers, including swimming pool covers and tarpaulins. In all cases, ammonia emissions were substantially reduced and, as a result, nitrogen was conserved in the manure. While recognizing that lagoon covers provide effective odour control, Sweeten (1991) cautioned that rigid covers are expensive while flexible membrane covers can be subject to damage from wind and photodegradation. Brundin and Rodhe (1994) observed that covers reduce evaporation and, especially if they do not keep the rain out, can result in an increase in required storage capacity.

**Scubbers and biofilters** - If manure is enclosed, either in the animal housing structure or in a storage, the possibility exists of treating the air coming out of the enclosure to remove odorous compounds. O'Neill et al. (1992) reviewed a variety of ventilation dependent treatment methods including incineration, atmospheric dispersion, chemical treatment, adsorption, absorption, biofilters and bioscrubbers. Of these, only atmospheric dispersion through chimneys, biofilters and bioscrubbers were considered to be potentially economically viable in agriculture. Although the projected costs of all three methods were of the same order, atmospheric dispersion is likely to meet with resistance from people concerned with air pollution and, therefore, only the last two methods will be addressed here.

The function of scrubbers is to remove odourous gases, principally ammonia, from air by solution in a liquid, usually water. In a bioscrubber, bacteria are used to nitrify the dissolved ammonia. In Europe, where concern with ammonia emissions is more pronounced than in North America, considerable work has been done on the development and design of bioscrubbers for animal housing (Scholtens et al. 1987; Schirz 1990; Scholtens and Demmers 1991). Ammonia removal rates of over 95% can be achieved with air flow capacities of up to 2000 L/s.

Like bioscrubbers, biofilters utilize microbial activity to degrade odourous compounds. However, in biofilters the air to be processed is passed through a porous matrix that supports microbial growth. Moisture for the bacteria must be available in the
matrix, but the air is not brought into contact with the free liquid. A wide variety of porous media have been used successfully in biofilters. These include peat (Daigle et al. 1987; Zeisig 1988; Williams and Miller 1992) peat/heather and bark/compost mixtures (Colanbeen and Neukermans 1989; Scholtens and Demmers 1991) various composts (Zeisig, 1988), straw (Oldenburg 1989) and soil (Sweeten et al. 1991). Reported performance of biofilters is similar to that of bioscrubbers but, in both cases, a high level of management and a knowledge of the biological processes involved is required for successful operation.

Although biofilters have been used to treat exhaust air from ventilation, possibly a more effective use would be to control manure odours by treating only the gases generated by the manure. This implies covering the manure storage and collecting those gases but would allow filters with lower flow capacity to be used.

**Oligolysis** - The term oligolysis refers to the passing of an electric current through liquid manure with the object of electrochemically removing or modifying odour-forming compounds. This technology has not been developed to the same extent as biofiltration but has proved effective in reducing odours. Yu et al (1991) and Coleman et al (1993) used steel electrodes to bind sulphide ions as ferrous sulphide, thereby reducing emissions of hydrogen sulphide. Sulphide removal rates of >95% were reported by these authors. In other studies, oligolysis using copper and carbon electrodes has been used to reduce ammonia concentrations in pig housing (Chiumenti and Donatoni 1988) and in rabbit housing (Muller et al. 1990).

**Slurry Application** - A major source of odour problems is the application of manure or slurry to the land. If the material is sprayed or allowed to lie on the surface for any length of time these problems are magnified. One approach to reducing these odours is to incorporate the material into the soil immediately or to inject the slurry directly below the soil. Traditionally this has been done through a tillage attachment on a slurry tanker but with heavy, loaded tankers this can lead to compaction and trafficability problems. This has been addressed by the development of "umbilical" incorporation systems (Godwin et al. 1990) where the incorporation is done by a tractor-mounted implement that is fed from a temporary storage tank by a trailed hose. High draft requirements, even with umbilical systems, have a negative effect on the economic viability of these systems (Brundin and Rodhe 1994) and a promising compromise might be the use of low-pressure drop tubes in association with an umbilical distribution system (Warner et al. 1990; Jones 1992). This reduces the draft requirement, keeps compaction to a minimum and virtually eliminates atomization of the slurry. However, the slurry is not incorporated and, depending on prevailing winds and rainfall, still has the potential to be an odour nuisance or a runoff pollutant.

**Odour characterization and source identification** - In assessing or describing the severity of an odour problem, or in establishing the effectiveness of odour prevention methods, there is a need for uniform measurement techniques and terminology. Also, in trouble-shooting existing odour problems, and in predicting the potential for odour problems in new or expanded facilities, knowledge of what materials and situations are responsible for different odours is useful. The characterization and analysis of manure odours is a rapidly-evolving area.

The human nose remains a most sensitive odour detector and methods of using this sensor in repeatable and accurate ways (the science of olfactometry) are becoming well established (Bundy et al. 1993; Jones et al. 1994). Although olfactometry provides a reliable measure of odour intensity, its application can be expensive and it does not provide reliable analysis of odour.
components. Chemical analysis, utilizing
techniques such as gas chromatography (GC) and
mass spectrometry (MS), can identify the various
volatile, odour-producing compounds but cannot
quantify the subjective effect of combining them in
various proportions. New technology utilizing
multiple conducting polymer sensors (Neotronics
1994) could help to bridge the gap between
olfactometry and chemical analysis and Hobbs et
al. (1995) compared one of these “electronic
noses” (EN) and a photo-ionization detector (PID)
with olfactometry and GC-MS methods. These
authors concluded that, while both instruments had
potential, neither was as sensitive as olfactometry.
The PID was more sensitive than the EN but the
latter could discriminate better between different
odours at higher concentrations.

MANURE MANAGEMENT
Reduction of odours will allow livestock enterprises
to be located in closer proximity to other activities
by diminishing the nuisance potential of the
operations. Nevertheless, even an odourless
operation has the potential to constitute an
environmental hazard and this must be addressed.
Manure management strategies must be adopted
to minimize pollution while, at the same time,
maximizing the potential benefit of the manure as
a resource. Simple store-and-spread systems are
unlikely to do either of these, particularly in larger
enterprises. Consequently other options must be
explored. The technologies outlined below,
although not necessarily new in themselves, are
emerging as having the potential to improve on
traditional standard practices.

Volume Reduction - A fundamental concept in
the management of any potential pollutant is to
reduce the amount of pollutant. Thus, it makes
sense to try to limit the amount of manure that has
to be handled or managed. From an engineering
point of view this implies the development of
designs and systems that use less flushing or
wash water and that require less bedding material
such as straw.

Solid-Liquid Separation - Rather than collecting,
treating or handling solid and liquid wastes
together, there are potential advantages in
separating the two and managing them in
appropriate ways, some of which are outlined
below. The separation can take place before
treatment, or at some intermediate stage before
final utilization of the product. Methods of
separation vary depending on downstream
requirements and the sophistication of individual
systems. Baader and Krause (1988) identified the
advantages of solid-liquid separation to include:

- reduction of uncontrolled separation and
  inhomogeneous distribution of nutrients
- lower viscosity of liquid and resultant easier
  pumping
- fewer blockages in pipes and nozzles
- easy heaping, composting and spreading of
  solids (provided they are fibrous and coarse)

Rudimentary, passive, solid/liquid separation takes
place in systems where seepage or leachate from
manure packs or piles is collected for separate
application or treatment. Where the manure is
collected as a slurry, however, other separation
processes are required and a wide variety are
available. These include various types of screens,
vacuum and pressure filters, belt and screw
presses centrifuges, and membrane processes
such as ultrafiltration (CSIRO, 1990). Piccinini and
Cortellini (1987) describe tests of
commercially-available centrifuges and stationary,
vibratory and rotating screens used in separating
slurries from pig and beef cattle operations. The
separating efficiencies observed depended on the
type of slurry being separated as well as the type
of separator. In general, however, centrifuges,
although more expensive, were better than screens
and dynamic screens were better than stationary
screens. In Canada, a centrifuge and a screw
press have been tested for the B.C. Hog Producers
Sustainable Farming Group (Yu 1993). These tests
indicated that the screw press was more
efficient in removing total solids but the centrifuge, used in association with a polymer flocculant, removed higher percentages of nutrients and BOD₅.

**Composting - Composting** refers to the aerobic degradation of organic materials and is certainly not new technology in manure management - Baeten and Verstraete (1988) referred to an aerobic composting operation that had been working for more than twenty years. Nevertheless, composting is receiving renewed interest and Krider (1992) presented composting as an innovative practice for utilizing animal wastes. The resurgence of interest in composting could be associated, in part, with developments in solid-liquid separation (e.g., Kack et al. 1994; Matsuda et al. 1994) but composting of solids has some inherent advantages anyway. These include:

- Reduction in moisture content and volume of solids to be handled and spread
- Composted material is easier to spread uniformly than raw manure
- Thermophilic temperatures during the composting process can kill pathogens and weed seeds
- Aerobic composting reduces odours during storage and spreading
- Relatively large proportions of nutrients in compost are in organic form making them less prone to leaching.

The term "composting" is usually associated with solid material and, in this context, numerous approaches have been explored for managing collected manure solids. Rynk (1992) provides a good practical guide to proven techniques and more recent publications indicate continuing interest in composting pig manure (Lo et al. 1993), broiler litter (Henry and White 1993), dairy manure (Van Horn et al. 1994) and beef feedlot manure (Eghball and Power 1994) to give just some examples.

Another approach to composting that is receiving attention, particularly with pigs, is that of using deep litter to achieve *in situ* treatment of manure. In these systems animals are housed on a bed of sawdust, chopped straw or other suitable carbon source. Manure is incorporated into the litter as it is produced and is degraded by microbial action generating heat which can be advantageous in cool climates. Management of the litter material to incorporate manure and keep it aerobic can result in airborne actinomycetes that can pose a health threat (Kay and Thomas 1993) and minimum ventilation rates may need to be increased to handle moisture given off during the process (Van't Klooster and Greutink 1993). Like other composting systems, however, this approach results in odour reduction and in a reduction in volume of manure to be handled (Van Schaijk 1993). Production of mature compost *in situ* is unlikely and provision should be made for additional composting of spent litter before land application.

So far, this discussion has been confined to composting of solids but there is also interest in so-called liquid composting systems (Skjelhaugen 1988). These involve aeration of slurries to promote aerobic bacterial activity. Process temperatures of 35/-45°C result in killing of weed seeds and pathogens and provide energy that can be recovered for heating. Depending on the system, the aerated liquid may have been separated from solids in a preceding operation (Matsuda et al. 1994). Other systems, not described as liquid composting, also utilize aerobic treatment of liquid effluent. These include the sequencing batch reactor (SBR) system developed by Lo et al. (1991) which has been treating separated pig effluent since 1988. The benefits of odour reduction, lower viscosity and reduction in nutrients and BOD₅ that are achievable by these aerobic systems must be weighed against their relatively high capital and running costs.

**Constructed Wetlands -** Also known as artificial wetlands and reed beds, constructed wetlands evolved from the realization that natural wetlands such as swamps, marshes and bogs had a
purifying effect on organically contaminated water passing through them. Whereas natural wetlands are generally unmanaged, constructed wetlands are designed and operated to maximize performance by providing ideal conditions for the growth of the plants (macrophytes) upon which these systems depend. Pescod (1992) subdivides the aquatic plants involved into floating and emergent macrophytes. Floating macrophyte systems use species such as water hyacinth (eichomia crassipes) and duckweed (lemna) which are characterized by large root systems that are efficient nutrient strippers and serve as living substrates for microbial activity.

Emergent macrophyte systems utilize species such as reeds (phragmites), cattails (typha) and bulrushes (scirpus) growing in saturated media and are classified as surface flow (SF) or subsurface flow (SSF) wetlands depending on the presence of a free water surface. According to Hamilton et al. (1993), SF systems are simpler to construct and maintain although SSF systems have advantages in odour and mosquito control and may prove superior in cold climates. Biddlestone et al. (1994) express some doubt that horizontal flow beds are best suited to handling the high strength materials typical of agriculture and describe a two-stage, downflow bed system that reduced BOD$_5$ of dairy effluent from 1190 mg/L to 60 mg/L.

In all systems, the major contaminant reducing mechanisms (Hamilton et al. 1993) are sedimentation, filtration, chemical precipitation and absorption, microbial interaction and uptake by vegetation. In addition, a key feature of constructed wetlands is the ability of many aquatic macrophytes to pass oxygen from the atmosphere to the root zone (rhizosphere) where it can support decomposition by aerobic microbial activity. Intuitively, constructed wetlands might seem to be ill-suited to environments subject to freezing and where plants have long periods of dormancy. However, Hamilton et al. (1993) and Jenssen et al. (1993) indicate that there is evidence to the contrary and that constructed wetlands are operating successfully in Canada and Scandinavia for treatment of municipal and industrial effluents. These authors indicate that, with SF systems, an insulating ice cap can be created over the system whereas SSF systems can be allowed to freeze to some depth as long as flow can continue below that. Although biological activity is slower at low temperatures, successful treatment will continue within the wetland down to temperatures of around 5°C which, aided by microbial activity, should be sustainable even when air temperatures fall to -30°C or below.

In the context of siting large animal production operations, the use of constructed wetlands for manure management would require suitable topography and drainage as well as sufficient area for treatment of the effluent stream, even in winter. On the positive side, such systems have a good environmental image and have low maintenance and running costs. Although the technology is new, several agricultural systems have been operated successfully and Krider (1992) identified this technology as having potential for innovative use of agricultural effluents. Biddlestone et al. (1994) provide details of two systems for treating pig and dairy effluent, and a recent annotated bibliography by Muirhead and Moerman (1994) provides references to several other systems.

Microalgal Systems - Fallowfield et al. (1994) describe the concept of a high-rate algal pond as a stirred shallow channel in which a dense culture of algae develops. Photosynthesis of the algae supplies oxygen for associated heterotrophic microorganisms that digest the organic waste in the pond. The resultant carbon dioxide production in turn supports the algal photosynthesis. Mechanical energy is used to provide circulation and to maintain the algae in suspension but, compared with mechanical aeration, this is 10-20 times more energy efficient. The algal biomass
must be removed from the water before discharge by settling or other means and can be composted or used as a feed (Taiganides 1992).

Algal systems depend on light penetration for photosynthesis and, therefore, are not suited to treatment of raw animal slurry. However, pre-treated, low-solids-content liquid can be treated this way. Fallow field et al. (1994) and Canizares et al. (1993) describe systems using algae as a secondary treatment for aerobically-treated swine waste while Noue and Bassees (1989) and Mahadevaswamy and Venkataraman (1986) used algae for treatment of effluent from anaerobic systems.

Anaerobic systems - In-vessel anaerobic treatment of animal manure has been of interest for a long time, principally because of the potential for energy recovery in the form of biogas. Previous studies (e.g., Feddes and McQuitty, 1981) questioned the economic feasibility of such systems, particularly in small to medium-scale installations. However, there has been a continued improvement in reactor technology (e.g. Lo et al. 1983; Sutter and Wellinger 1988; Wellinger et al. 1992) and these systems should not be ruled out for larger enterprises. Wellinger et al. (1992) state that over 500 agricultural biogas plants are in operation in Europe.

Wase and Thayanithy (1994) list some of the problems associated with anaerobic systems to include:

- High capital and running costs
- Disposal of digested solids
- Requirement of a high level of control and technical knowledge
- Hazardous nature of the biogas produced
- Susceptibility of the process to inhibition by pesticide residues, hypochlorite, etc.

Nevertheless, these authors conclude that anaerobic digestion can be viable given suitable conditions and competent management. One of the problems associated with biogas digesters in cold climates was the need to maintain thermophilic temperatures. This has been at least partially addressed by the development mesophilic reactor technology which is now well established (Sutter and Wellinger, 1988; Ahring et al. 1992) and, in any case should not be a problem with adequately insulated vessels.

Other Possibilities - The above is not an exhaustive treatment of all the technologies that could be applied to manure management. It is merely an attempt to highlight those technologies that seem to offer combinations of satisfactory performance and economics that make them of current interest. Other technologies exist such as pyrolysis, gasification ultrafiltration, etc., that have been demonstrated to be technically feasible, mainly at the laboratory scale. These might develop in time to become attractive options but are not seen as being currently emergent.

FACTORS INFLUENCING ADOPTION
In order for new technologies to be adopted a number of criteria must be satisfied. Failure to satisfy any of these will bring the technology into ill-repute and may severely retard its adoption. Some of these criteria and possible methods of satisfying them are outlined below.

Proven performance under local conditions
- A prime requirement of any technology is that it works. Furthermore, it must meet operational specifications under the prevailing conditions (environmental and economic). The best way of establishing adequate performance is by demonstrating the technology under local conditions. Thus, demonstration and extension efforts are vital in this regard. A good example is the farm-scale SBR system described by Lo et al. (1991).

Appropriate level of sophistication
- Successful application of all the technologies discussed above demands an understanding of the fundamental principles involved. Operators need to be trained adequately whether they
are applying the relatively simple concepts of composting or operating a complex biogas digestion facility. In relation to biogas technology Wase and Thayanithy (1994) stress that operators must not only be technically able but they must also be committed to the success of the system. Both of these can be enhanced by suitable training and, particularly in large installations, specialist waste management technicians could be justified.

**Economics** - The importance of the "bottom line" cannot be over-stressed and good data are required so that sound analysis and decisions can be made. These data must attempt to include an accounting of environmental costs and benefits. With many of the technologies discussed, economies of scale are undoubtedly achievable and recent trends in increasing sizes of livestock enterprises enhance their viability. This does not mean however that good technologies should be denied to the smaller producer. Opportunities should be explored for combining agricultural or agricultural and municipal / industrial waste streams in centralized processing facilities such as that described by Ahring et al. (1992). Planning and monitoring of such systems could be aided by the use of Geographical Information Systems (GIS) to identify suitable sites and participants (Leonard 1993).

**CONCLUSIONS**

- Economic and environmental trends are creating a demand for enhanced methods of handling effluent from intensive animal production facilities.

- Because of its nuisance value, control of odour has a high priority and a variety of methods for doing this effectively are emerging. These methods can reduce the nuisance value and, consequently, reduce required separation distances and increase siting options.

- Trends in manure management point towards reduction in the volume of material to be handled and towards handling manure in separate liquid and solid streams. Technologies for doing this are available.

**ACKNOWLEDGEMENTS**

The authors wish to acknowledge the assistance of Doug Mackay in assembling a good deal of the literature upon which this paper is based. They also acknowledge the assistance of numerous others who contributed ideas and materials - notably Brian West of Alberta Agriculture, Food and Rural Development, Yuanhui Zhang of the Prairie Swine Centre, John Luymes of the B.C. Ministry of Agriculture, Fisheries and Food, and J.C.Yu at the B.C. Hog Commission.

**REFERENCES**


Baader, D., and W.Verstraete. 1988. Manure and municipal solid waste fermentation in


PAMI 1993. Hog lagoon odour control - a treatment using straw. Research update 698, Prairie Agricultural Machinery Institute, Humboldt, SK.


REGIONAL DISTRIBUTION OF MANURE MAY MITIGATE NUTRIENT-RELATED OBSTACLES TO SITING OF LIVESTOCK AND POULTRY OPERATIONS

Dr. Rob Janzen
University of Alberta Edmonton, Alberta

Concerned with nutrient transformations during composting livestock manure; composting in cold climates; emissions of CO₂ and N₂O from soil amended with manure, biosolids, or compost; and patterns of manure production and use in Alberta

Co-author: W.B. McGill, Department of Renewable Resources, University of Alberta, Edmonton, Canada

ABSTRACT

Nutrient management, in our view, is an issue for siting of poultry and livestock operations because manure is considered a waste and therefore tends to be spread at excessive rates near production facilities. The aim of this paper is to explore the idea that marketing manure as a resource could promote regional distribution and thereby could mitigate localization of nutrients and odors that are current obstacles to siting of operations.

Using Alberta as a case study, we asked the question: "what is the current pattern of manure supply and distribution?". We calculated nutrient balances in Alberta municipalities in 1991 using estimates of (i) excretion of nitrogen (N) and phosphorus (P) by confined livestock, (ii) purchase of fertilizer N and P, and (iii) removal of N and P in harvested grain. According to these estimates (i) the amount of nutrients excreted per unit area of land receiving manure was 10-fold higher than the average application of fertilizer, (ii) the rate of manure spreading in a municipality may be correlated to the proportion of excreted nutrients originating from feedlot cattle, (iii) municipalities with excreted manure nutrients in excess of that harvested as grain were adjacent to municipalities with nutrient deficits, and (iv) N and P worth about $167 million was excreted in 1991. Our analysis supports the conclusion that agricultural markets for manure potentially exist near concentrations of livestock in Alberta.

A fundamental question emerges regarding nutrient management and siting of livestock operations in the next decade: "can regional distribution of manure resources be achieved?". Focusing on this question would have implications for nutrient management. First, consideration should be given to shifting the focus of nutrient management from landbase requirements for local spreading to diversion of manure resources to inter-municipal or regional markets. Second, to provide a knowledge basis for this diversion, a change in the focus of
nutrient management research may be warranted; namely, to quantify the benefits of efficient harvest, innovative processing and effective use of manure and manure-derived resources.

INTRODUCTION

Typically, the focus of manure nutrient management is on knowledge of biogeochemical cycling of manure nutrients, and on using this knowledge to engineer compatible technology and to implement appropriate management plans. This approach has tended to emphasize the local, usually at the single farm level, integration of manure production and crop production (Westphal et al. 1989, Bacon et al. 1990, Hansen and Ostergaard 1992, Barry et al. 1993). Environmental liabilities associated with manure use have also been assessed. These include nitrate leaching and phosphorus accumulation with spreading of manure in excess of plant nutrient requirements (Chang et al. 1991), eutrophication of surface waters following addition of manure to soils subject to erosion (Daniel et al. 1994), and emission of nitrous oxide from manure-amended soil (Paul et al. 1993, Nielsen and Revsbech 1994). Finally, an important assumption embedded in this approach, especially as it relates to the siting of livestock and poultry operations, appears to be that manure has little or negative value, so "environmental regulators need to be more vigilant since a producer's incentive may be to apply excessive amounts on land nearest the storage facility" (Roka and Hoag 1994).

To attempt to stimulate discussion, we have adopted an alternative paradigm. First, although manure needs to be recycled in crop production, we propose that this integration could be explored at the municipal or regional level. The potential importance of off-farm options for nutrient management have been articulated by other investigators (Beegle and Lanyon 1994, Smolen et al. 1994, Van Horn et al. 1994). Second, in the process of mitigating potential environmental liabilities, nutrient management research has the opportunity to quantify the economic benefits captured by effective use of manure and manure-derived products. Some current research already considers potential benefits, for example, with respect to rate of nutrient availability from manure (Klausner et al. 1994). The scope of knowledge to be integrated in a comprehensive value of manure and manure-derived resources, however, ranges from improvement of soil physical properties (Wrigly and May 1992, Dick and McCoy 1993) to suppression of some plant diseases (Grebus et al. 1994). Third, the foundation of our approach is that increasing manure resource value through effective marketing is a better means to achieve environmentally compatible and economically beneficial use than is some form of regulation. The aim of our approach, then, is to explore the idea that marketing manure as a resource, supported by evidence derived from rigorous biophysical investigations, could promote regional distribution and thereby could mitigate local nutrient-related obstacles to siting of operations.

Our approach is inspired by the expectation that through the next decade economic factors will continue to favour the trend to larger production units on smaller land base. This trend is driven first by decreased cost of production achieved with increasing size of operation. Using information collected by the Alberta Cattle Feeders Association, Kotelko (1995) reported that the cost per head to finish beef cattle decreases from $240 for feed yards with capacity of less than 2 000 head to $175 for feed yards with capacity of more than 10 000 head. Similar assessments have been made concerning the dairy industry. Jeffrey (1994) argues that increasing herd size is one of the key requirements to compete effectively with American milk producers under freer trade. A second factor is that purchasing sufficient land to meet Alberta guidelines for manure application can decrease the net return on investment. For example, acquiring the recommended land base would account for about 18% of the capital cost of a 1200-sow farrow-to-finish facility with a computerized feedmill, but would provide only about 2.5% of the projected net income (Janzen and Janzen
1995). The current guidelines for manure use in Alberta acknowledge spreading on their own land is not the only appropriate nutrient management strategy for livestock operations. The Code of Practice for the Safe and Economic Handling of Animal Manures (Alberta 1995) states: "Land suitable for utilizing available manure nutrients should either be owned by the livestock owner or access arrangements made with neighbouring land owners by informal/formal contract or easement". We conclude that, since diverting manure resources to neighbours is increasingly the economic choice of livestock operations, nutrient balances at the farm level may not be an appropriate criterion for siting of livestock operations. Indeed, we propose it may be reasonable to investigate marketing of manure resources on a municipal or regional level to gain further economic, and likely some environmental, benefits.

Our paper has two main components. First, using Alberta as a case study, we examine the current pattern of manure supply and distribution to determine how far manure resources need to be transported to achieve effective use. Second, based on the evidence that agricultural markets for manure resources exist near concentrations of livestock in Alberta, we discuss the knowledge and technology that could be required to capture these potential markets.

ESTIMATING 1991 BALANCES OF NITROGEN AND PHOSPHORUS IN ALBERTA

We used data from the 1991 Canada Census, from the Agriculture Financial Services Corporation and from a summary for the CAESA Water Quality Monitoring Committee (Snowy Owl Software 1993) to calculate nutrient balances based on the supply and distribution of manure and fertilizer nutrients and the harvest of grain in rural municipalities of Alberta.

To estimate the quantities of N or P excreted in Alberta, we applied published nutrient production factors (Young et al. 1982, Young et al 1987) to the numbers and kinds of animals from the census data. Furthermore, to distinguish manure excreted by animals in confinement from that excreted by those on extensive grazing lands, we assume that two thirds of the manure predicted from bulls, beef cows and calves, sheep and horses and ponies is excreted during grazing, and thereby recycled. The database of the Farm Fertilizer Price Protection Plan was used to obtain municipal level estimates of fertilizer purchases. Because this provincial program was discontinued after the 1991 crop year, it is the last year for which municipal-level fertilizer data is available, and therefore is the year for which we chose to estimate nutrient balances.

Yields of wheat, barley, oats and canola by municipality in 1991 (weighted average of yields on stubble and fallow) were provided by the Agriculture Financial Services Corporation of Alberta Agriculture, Food and Rural Development. Removal of nutrients in harvested grain was estimated according to predicted N and P content of the grain (Goettel 1987).

N AND P BALANCES - PROVINCIAL LEVEL

On 04 June 1991 (Canada Census day), the numbers of livestock on Alberta farms were: (i) 10 090 500 poultry (chickens, turkeys, ducks, geese); (ii) 4 757 000 cattle, including 1 559 000 calves, 989 000 feeder heifers and steers and 153 000 dairy cows and heifers;

(iii) 1 730 000 pigs, including 184 000 sows; (iv) 305 500 sheep and lambs; and, (v) 109 000 horses and ponies. On the day of the 1991 Canada Census, then, Alberta contained about 37 % of the cattle and calves, about 52 % of the feeder cattle, and about 17 % of the pigs in Canada (Agriculture Statistics Yearbook 1993). The largest populations of poultry and livestock are in Regions 2 and 5 (Table 1), primarily because these regions contain the most reliable sources of water in the province - Region 2 contains most of the irrigated land in Alberta, and Region 5 has good supplies of surface and ground water (MacAlpine et al. 1994).
We estimate that in 1991 161 000 tonnes of N and 44 000 tonnes of P was excreted as manure that needed to be collected and distributed to be used effectively. According to the Farm Fertilizer Price Protection Plan, 308 000 tonnes of N and 57 000 tonnes of P were purchased as fertilizer in Alberta in 1991. Thus, the amount of N and P purchased as fertilizer is less than 2-fold more than that excreted as manure by confined animals, but fertilizer is applied to more than 16-fold more cropped land (Table 2). As a result, the amount of nutrients excreted per area of land receiving manure is more than 10-fold higher than the average application of fertilizer.

Much of the excreted N likely is lost during storage and handling; indeed, the Alberta guidelines for manure use (Code of Practice 1995) assumes this to be the case for open feedlot conditions. Power et al. (1994) conclude that in the Northern Great Plains "about 50% of the N excreted in feedlot manure is lost before the manure pack is removed from the feedlot." Where manure N is added to soil in excess of plant requirements, further losses would be expected after application and incorporation. Accumulations of readily available N in soil drive processes such as ammonia volatilization, nitrification, leaching and, where these accumulations occur with soluble carbon as is the case in manure, denitrification. Conversely, P tends to be conserved; P is not lost as gas and is not readily leached. The majority of the excreted P, then, would be retained and consequently would accumulate where the

Table 1. Distribution of livestock and poultry in Alberta, 04 June 1991. Region numbers increase from south to north.

<table>
<thead>
<tr>
<th>Census Region</th>
<th>Cattle</th>
<th>Swine</th>
<th>Poultry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Dairy</td>
<td>Feeders</td>
</tr>
<tr>
<td>1 a</td>
<td>433 500</td>
<td>5 000</td>
<td>54 000</td>
</tr>
<tr>
<td>2 b</td>
<td>783 500</td>
<td>24 500</td>
<td>345 500</td>
</tr>
<tr>
<td>3 c</td>
<td>743 500</td>
<td>21 000</td>
<td>155 500</td>
</tr>
<tr>
<td>4a d</td>
<td>427 000</td>
<td>7 000</td>
<td>91 000</td>
</tr>
<tr>
<td>4b e</td>
<td>422 500</td>
<td>12 500</td>
<td>54 500</td>
</tr>
<tr>
<td>5 f</td>
<td>974 500</td>
<td>62 500</td>
<td>173 500</td>
</tr>
<tr>
<td>6 g</td>
<td>700 500</td>
<td>16 000</td>
<td>90 500</td>
</tr>
<tr>
<td>7 h</td>
<td>272 000</td>
<td>4 500</td>
<td>24 500</td>
</tr>
<tr>
<td>Province</td>
<td>4757000</td>
<td>153 000</td>
<td>989 000</td>
</tr>
</tbody>
</table>

a Cypress, Forty Mile (SAs 2, 3, 4).
b Warner, Lethbridge, Taber, Newell, Vulcan, Wheatland, Starland, Kneehill.
c Cardston, Pincher Creek, Willow Creek, Foothills, Rocky View, Mountain View.
d Provost, Paintearth, Stettler, Flagstaff, Wainwright.
e Camrose, Beaver, Minburn, Vermilion River, Two Hills, Lamont.
f Red Deer, Lacombe, Ponoka, Clearwater, Wetaskiwin, Leduc, Brazeau, Parkland, Strathcona, Sturgeon.
g Bonnyville, St. Paul, Smoky Lake, Lac Ste. Anne, Barrhead, Westlock, Thorhild, Athabasca (IDs 14, 15, 18).
h Grand Prairie, Smoky River, Spirit River, Fairview, Peace (IDs 16, 17, 19, 20, 21, 22, 23).
manure is spread (Watts et al. 1992). Losses of N and accumulations of P both represent ineffective use, or waste, of manure nutrients. About 367 000 tonnes of N and 65 000 tonnes of P were harvested as wheat, barley, oats and canola grain in 1991. Thus, the sum of nutrients excreted by confined livestock and nutrients purchased as fertilizer amounted to 102 000 tonnes of N and 35 000 tonnes of P surplus to grain removals, but neither manure nor fertilizer alone would supply sufficient nutrients to replace those removed as grain.

**N AND P BALANCES - MUNICIPAL LEVEL**

When the provincial nutrient balance is dissected to examine nutrient use by municipality, interesting patterns emerge.

First, the rate of manure nutrient addition exceeds that from fertilizer in all regions in Alberta (Table 2). Even in Region 4b with the lowest rate of manure application, manure N exceeds that from fertilizer by 6.4-fold and manure P exceeds that from fertilizer by 9.4-fold.

According to our estimates, then, fertilizer application rates are similar to nutrient removals by crops. Furthermore, although Regions 2 and Region 5 have similar numbers of livestock and poultry, the average proportion of land amended with manure, and hence the apparent application rate, in municipalities of Region 2 is more than 2-fold higher than in those of Region 2. If high rates of excretion per land area receiving manure is accepted as evidence of ineffective use of nutrients, then density of livestock operations and use of manure in the municipality do not appear to be related.

Second, the rate of manure spreading in a municipality may be explained in part according to the proportion of excreted nutrients originating from feedyards (i.e. feeder cattle) or from barns (i.e. dairy, poultry and swine). The increase in N excreted per area of land receiving manure is significantly correlated ($P = 0.0000001$) to increasing proportion of the manure in a municipality from feedyards (Figure 1), although this linear correlation does not account for a large proportion of the variability ($R^2 = 0.3717$).

Thus, the municipalities in Region 2 averaged 59.2 % of manure from feedyards and 21.7 % from barns, while those in Region 5 averaged 32.9 % from feedyards and 32.3 % from barns. It is important to reiterate that likely much of the N from feedyards is lost to the atmosphere before manure is spread on land. The rates of N excreted per area of land receiving manure should therefore be interpreted as potential, acknowledging that especially in areas where feeder cattle are the dominant source of manure, more effective use of manure N likely depends as much on improved harvest techniques as on longer distribution distances. The estimated rate of manure P application, however, similarly increased with proportion of manure from feeder cattle ($y = 12.81 + 0.13x$, $P = 0.0000001$, $R^2 = 0.3684$). Because P tends to be retained in manure, excessively high rates of spreading associated with feedyards are solely a distribution, and not a harvest, issue.

Third, municipalities with excreted manure nutrients in excess of that harvested as grain are adjacent to municipalities with nutrient deficits (Figure 2). For example, the County of Lethbridge has estimated 5 750 tonnes of surplus N and 2 343 tonnes of surplus P, but adjoins five municipalities with collective estimated deficits of 32 000 tonnes of N and 4 094 tonnes of P. Three of these adjoining municipalities have an individual deficit larger than the surplus in the County of Lethbridge. Indeed, all of the municipalities in Alberta with excreted manure N in excess of grain removals have at least one adjoining municipality with a deficit sufficient to accommodate the entire surplus. When at least two municipalities are considered, nutrients from confined animals were excreted in amounts less than that removed as harvested grain in 1991.
Figure 1. Potential rate of manure spreading correlated to the proportion of manure originating from feeder cattle in 1991 in Alberta municipalities.
Figure 2. Distribution in Alberta in 1991 of nitrogen excreted as manure relative to nitrogen removed as grain at the municipal level. Municipal nitrogen balance calculated as \((N\text{ excreted as manure by confined livestock and poultry}) - (N\text{ harvested as barley, canola, oats and})\).
Figure 3. Contribution of purchased fertilizer to the nitrogen balance in Alberta municipalities in 1991. Municipalities sorted from left to right in descending order of total N.
In January of 1995, the cost in the Edmonton area of urea fertilizer (46-0-0) was about $295 per tonne, and that of ammonium phosphate (11-51-0) was about $400 per tonne, representing a value of $640 per tonne of N and $1450 per tonne of P. The estimated value of the nutrients excreted in 1991 by confined livestock in Alberta is therefore $167 million. This converts to $11.10 for N and $6.90 for P per hectare of cropped land. Using the 1995 retail prices, the fertilizer purchased in 1991 would have cost $280 million, or $21.20 for N and $8.90 for P per cropped hectare. To put these values in perspective, the realized net farm income (RNI) - return to equity, management, risk and unpaid family labour in a given year - in Alberta was $107 million in 1990, negative $32 million in 1991, $564 million in 1992 and $394 million in 1993 (Agriculture Statistics Yearbook 1993). In other words, from 1990 to 1993 the average RNI can be represented as $27.80 per cropped hectare. Much of the N excreted likely is not recycled for crop use under current practices and some cost is incurred to harvest and distribute manure resources, but the potential contribution of manure N and P to the farm economy could be significant.

Finally, when assessed within our framework, fertilizer rather than manure can be considered the source of potential nutrient excess when the total budget of nutrients (e.g. fertilizer N + manure N - grain N) in municipalities is calculated (Figure 3). Thus, although the amount of N from confined livestock was 4000 tonnes higher in Region 2 than in Region 5, large purchases of fertilizer N in Region 5 resulted in a N surplus 23500 tonnes higher than that in Region 2. Trachtenberg and Ogg (1994) present a parallel concept, estimating that U.S. farmers spend $470 million to $624 million per year on N fertilizer unnecessarily (24 to 33% of annual N purchases), because of inadequate "credit" given to N from legumes and manures. This figure thus illustrates our view that, apparently contrary to dominant practice, existing manure resources can be considered the first source of nutrients to be supplemented by fertilizer when necessary.

**ECONOMIC VALUE OF N AND P IN ALBERTA**

The minimum economic value of manure and compost, in our view, can be assessed in terms of equivalent amount of fertilizer N and P. We include total, not only 'available', manure nutrients in our analysis, because residual nutrients become available to subsequent crops (Klausner et al. 1994). In January of 1995, the cost in the Edmonton area of urea fertilizer (46-0-0) was about $295 per tonne, and that of ammonium phosphate (11-51-0) was about $400 per tonne, representing a value of $640 per tonne of N and $1450 per tonne of P. The estimated value of the nutrients excreted in 1991 by confined livestock in Alberta is therefore $167 million. This converts to $11.10 for N and $6.90 for P per hectare of cropped land. Using the 1995 retail prices, the fertilizer purchased in 1991 would have cost $280 million, or $21.20 for N and $8.90 for P per cropped hectare. To put these values in perspective, the realized net farm income (RNI) - return to equity, management, risk and unpaid family labour in a given year - in Alberta was $107 million in 1990, negative $32 million in 1991, $564 million in 1992 and $394 million in 1993 (Agriculture Statistics Yearbook 1993). In other words, from 1990 to 1993 the average RNI can be represented as $27.80 per cropped hectare. Much of the N excreted likely is not recycled for crop use under current practices and some cost is incurred to harvest and distribute manure resources, but the potential contribution of manure N and P to the farm economy could be significant.

---

**Table 2. Use of nitrogen and phosphorus from fertilizer and from confined animals (on freshly excreted basis) by region in Alberta in 1991.**

<table>
<thead>
<tr>
<th>Census Region</th>
<th>Fertilizer</th>
<th>Manure</th>
<th>Land</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>P</td>
<td>Land</td>
</tr>
<tr>
<td>1</td>
<td>25.3</td>
<td>5.8</td>
<td>34</td>
</tr>
<tr>
<td>2</td>
<td>45.4</td>
<td>9.6</td>
<td>71</td>
</tr>
<tr>
<td>3</td>
<td>44.5</td>
<td>8.5</td>
<td>76.2</td>
</tr>
<tr>
<td>4a</td>
<td>39</td>
<td>6.9</td>
<td>79.1</td>
</tr>
<tr>
<td>4b</td>
<td>48.6</td>
<td>8.7</td>
<td>83.4</td>
</tr>
<tr>
<td>5</td>
<td>49.9</td>
<td>9.2</td>
<td>64.3</td>
</tr>
<tr>
<td>6</td>
<td>47.2</td>
<td>7.5</td>
<td>54.2</td>
</tr>
<tr>
<td>7</td>
<td>53.5</td>
<td>8.9</td>
<td>65.7</td>
</tr>
<tr>
<td>Province</td>
<td>46.1</td>
<td>8.3</td>
<td>68.6</td>
</tr>
</tbody>
</table>

* The percentage of cropped land amended with fertilizer or manure.
The area in Alberta seeded to canola has increased from 1,210,000 ha in 1991 to an estimated 2,020,000 ha in 1994, corresponding to a decrease of 620,000 ha in wheat area and 200,000 ha in barley area. From the perspective of nutrient management, the implication of this shift in cropping patterns is that canola has higher requirements for sulfur (S) (Goettel 1987). Using average yields for 1984 to 1993 (Agriculture Statistics Yearbook 1993), the S requirement per hectare for canola is 8.5 kg compared to 5.0 kg for barley and 2.5 kg for wheat, resulting in an estimated increased S requirement of 4,420 tonnes in Alberta. Based on this transition from production of cereals to canola, the value of S in manure and manure-derived resources may become increasingly important in western Canada.

The potential economic value of trace elements in manure and manure-derived resources is equivocal. On the one hand, the potential for manure resources to correct deficiencies of micronutrients has been documented (Gallardo and Nogales 1987, Dick and McCoy 1993). With more sensitive technology for analysis, knowledge of the occurrence and implication of such deficiencies is advancing. For example, the incidence of ergot in wheat and barley increases in soils deficient in copper (Evans 1995). On the other hand, trace elements derived from mineral supplements and plant materials in feed tend to be concentrated in manure, and especially in compost. The Composting Council of Canada states that the permissible concentration of trace elements is the “most difficult and often the most controversial” issue regarding compost quality standards (Composting Council of Canada 1995). Thus, depending on feeding regime and manure processing, trace elements may add value to manure resources or restrict their use.

Compost has also been shown to impart additional benefits to crops, such as improved soil physical conditions (Dick and McCoy 1993) and suppression of plant diseases (Hoitink et al. 1993). A thorough analysis of such attributes of compost is beyond the scope of this paper and will not be treated further here.

ENVIRONMENTAL VALUE OF N AND P IN ALBERTA

The environmental value of manure nutrients can be assessed according to the energy consumption and ‘greenhouse gas’ emission associated with manufacturing and distributing alternative nutrients. The industrial production of a tonne of N as urea fertilizer requires 1,700 m³ of natural gas and results in the emission of 3.4 tonnes of carbon dioxide (Beaton et al. 1976). Thus, if we limit our consideration only to the manufacture of fertilizer N, effective use of the N excreted by confined animals in Alberta in 1991 would save 270 million m³ of natural gas and 540,000 tonnes of carbon dioxide. According to Pimentel (1980), producing P fertilizer requires about 17% as much energy as is needed for N fertilizer. But, harvesting and distributing manure also requires energy, resulting in emissions of ‘greenhouse gases’. Analysis, therefore, of the total environmental cost of using manure or compost compared to using fertilizer is necessary. Downing (1975) concludes that decreased use of fertilizer can increase the energy output/input ratio by a factor of 2 or more. The challenge would remain to attach economic value to these potential environmental benefits; perhaps, for example, the users of manure resources could sell “carbon credits” to enterprises that emit ‘greenhouse gases’.

ASSESSING POTENTIAL TO INCREASE DISTRIBUTION OF MANURE RESOURCES

The preceding analysis provides evidence that, distributed on an inter-municipal or regional basis, nutrients excreted by confined livestock in Alberta in 1991 did not exceed amounts which could be used effectively in crop production. The analysis, however, also provides evidence to support the conclusion that excreted nutrients were not distributed effectively in 1991. Thus, we infer that, although municipal- and regional level distribution may mitigate local nutrient related obstacles to siting
operations, development of agricultural markets is required to achieve distant distribution of manure resources.

ROLE OF COMPOSTING TO INCREASE DISTRIBUTION OF MANURE RESOURCES

Composting has promise as a technology to achieve greater distance of distribution. The supply and composition of manure varies significantly with source, with handling and with time. Composted manure on the other hand is decreased in mass, has improved materials management properties and is sufficiently biostable to permit an inventory of characterized product. Furthermore, composting potentially introduces benefits, such as suppression of some plant diseases (Hoitink and Fahy 1986), in addition to those achieved by amending soil with 'raw' manure. Composting, however, also has disadvantages, most prominent of these is the typical loss of nutrients by leaching and/or volatilization. Therefore, we are not promoting composting as a universal solution to nutrient management - other strategies have been demonstrated to extract benefit from manure resources and therefore could be used to finance regional distribution of nutrients. The AgSTAR Program, for example, reports that collection of methane from manure digestion at a 500-cow dairy has decreased annual operation and maintenance costs by US $53 000, an annual return on investment of 21 (AgSTAR 1994). Also, centralized generation of methane and electricity has been proposed as an economically feasible strategy for treatment of manure from the dairy herds (10 000 head) of Tillamook County in Oregon (Hashimoto et al. 1994). Following energy recovery, however, composting can stabilize and decrease the mass and water content of the effluent (Kayhanian and Tchobanoglous 1993). Composting thus has the potential, directly or as a component of another resource extraction technology, to enhance the marketability of manure resources.

The role of compost to increase the marketability, and hence the distance of distribution, of organic materials including manure is gaining in importance. Speaking to the fifth annual conference of the U.S. Composting Council, William Ruckelshaus, CEO of Browning-Ferris Industries, predicted that potential end-markets for compost, rather than avoided costs of waste management, are driving the industry to the "edge of explosive growth" (McEntee 1994). In a commentary for BioCycle magazine, d'Aquin (1994) proposed that the network of fertilizer dealers serving commercial agriculture could be used to develop and supply an agricultural market for composted manure. As evidence that such an arrangement is feasible, d'Aquin gives the example of an "organically enhanced fertilizer" containing composted poultry litter and fertilizer, marketed by Crop Production Services of Tulsa, Oklahoma. "Sustane" is a compost product produced from poultry manure in Minnesota and distributed internationally, primarily for amendment to turfgrass (Steuteville 1995). This product is marketed as a slow-release source of nutrients and as a biological control of disease, pointing to the potential for compost to capture value in addition to nutrient content. It is perhaps reasonable to consider the possibility that compost will gain a share of agricultural markets for soil amendments.

We have focused here on agricultural markets because they represent the largest potential demand for soil amendments and virtually all livestock and poultry operations are sited near agricultural activity. Agricultural markets, however, have a small margin and are driven strongly by evidence of economic benefit. Retail markets for bagged compost are relatively small and nearly saturated (Buhr et al. 1993). But, if possible, livestock operations would do well to distribute their manure resources to the smaller but more lucrative markets in the horticultural, turfgrass management, organic agricultural and soil reclamation sectors (Composting Council of Canada 1995). Since a positive economic benefit is a criterion for decision making in most business enterprise, however, the gap in knowledge we will identify with respect to developing agricultural markets likely applies to all potential markets.
KNOWLEDGE REQUIRED TO DEVELOP AGRICULTURAL MARKETS FOR MANURE RESOURCES

A fundamental gap in the knowledge required to support analysis of economic benefit is the lack of capability to predict soil or crop response to compost amendment. In this we concur with the Composting Council of Canada, which states, citing Avnimelech et al. (1993), that "the irreproducibility of benefits" makes farmers reluctant to use compost (Composting Council of Canada 1995).

Enhancing the knowledge base to improve predictive capability, in our view, could proceed with two complementary objectives. First, predictive capability would be enhanced by standards of compost quality. Because the potential benefits of compost have biological, chemical and physical aspects, standards should address all of these characteristics of compost (Inbar et al. 1993, GCG Dillon and E & A Environmental Consultants Inc. 1994, Leonard and Ramer 1994). These standards could serve both as means for generic classification of composts and as targets for the production of `optimum' composts. Using a standard classification of compost, quantitative investigation of individual aspects of costs and benefits associated with compost use could be integrated in generalized understanding. For example, Grebus et al. (1994) have identified properties associated with the suppression of plant disease by compost derived from yard trimmings. Second, identifying the definitive characteristics to be specified in compost quality standards and linking the standard characteristics to soil and crop responses, requires mechanism- and process-level investigation. Investigation of integrated parameters such as soil structure or crop yield, without attention to the mechanisms and processes integrated in them, defeats the effort to obtain the generalized knowledge that is the foundation of predictive capability. Mechanism- and process-level investigation, linked to economic analysis through a standard classification scheme, is an important compost, and subsequently of achieving increased distribution of manure resources.

CONCLUSIONS

Using Alberta as a case study, our analysis supports the conclusion that nutrient management may not be an obstacle to siting of intensive livestock and poultry operations if regional distribution of manure can be facilitated. In areas of Canada where soil type, landscape morphology or climate increase the likelihood of surface or ground water pollution, the urgency to harvest, process and market manure resources may be reinforced by environmental factors.

Compost is a promising component of the technology needed to achieve regional distribution of manure resources.

Mechanism- and process-level investigation (i) to relate compost amendment to soil and crop responses and (ii) to develop standards of compost quality is required to use manure resources with predictable economic benefit. Obtaining the knowledge base to predict benefits of compost use is a key to the feasibility of regional marketing of manure resources.

IMPLICATION

The current land base requirement for siting of large intensive livestock and poultry operations is considered a constraint on the economic viability of production. If wasting nutrients is considered a form of environmental degradation, however, current land base requirements may also compromise environmental compatibility of production. For example, the recommended land base for cattle feedyards in Alberta ranges from 0.06 ha of irrigated land per head to 0.11 ha of non-irrigated land in the Dark Brown or Brown soil zone (Code of Practice 1995). These guidelines correspond to potential
spreading rates, on the basis of N excretion estimates, up to 20-fold higher than the estimated uptake of N by crops. If regional distribution of manure could be achieved, perhaps economic motivation to harvest, process and market manure would lead to more effective use of resources.

REFERENCES


In each of two sessions, workshop participants were divided randomly into six groups to address three different questions or concerns. Following short sessions, a delegate from each group presented the group's findings to the attendance at large. Duplicate questions or concerns were given to different groups. Thus in one session with six groups, three duplicate questions would be given. The following gives the response of each of two groups to the questions. There was a total of two sessions during the workshop.

In retrospect, the questions posed entailed more than groups could answer in the short time allotted. However, the exercise proved an excellent vehicle to present the breadth of the knowledge that existed, as well as the gap that remained regarding resolution of problems.

The following response texts have been left largely in the voice of the spokesperson for the group, except for minor editing.

**SESSION ONE**

**QUESTION 1**

What impacts are the land use planning, legal implications and various policies going to have on siting facilities?

What directions should various government levels (federal, provincial, municipal) be taking? Priority actions required (by group : federal, provincial, producer groups etc.).

Top two follow-up actions recommended from this workshop.

**RESPONSE A**

Concerning the impacts of land use planning on siting facilities, a couple of points came up. One was that one of the results could be a sort of "ghettoization" of production facilities into those municipalities that have the slackest requirements; this is a negative aspect. There could be some relocation of animal industries to those locations that are perceived to have the least stringent requirements. On the other hand, good planning can result in a clear set of guidelines, a clear game plan and a clear set of rules which provides stability for people establishing facilities and so on -- good planning can be a real plus. Another result of good planning and good clear guidelines is that there is likely to be fewer horror stories and fewer negative publicity incidents for the industry as a whole. Thus there are some positive and maybe some negative things about the current situation and the situation in the future.

What direction should the various government levels should be taking -- I think the key thing here is that there is a real need to create a level playing field across all the municipalities in the province, and between the provinces across the country, and they should be taking steps towards establishing that level playing field or at least pursuing some coordinated set of guidelines right across the country. There was some talk about the fact they should be promoting technology that will aid the siting of intensive livestock operations in proximity to other uses and so on. A producer in our group was rather vocal in saying that the government shouldn't be providing research money because he felt that there is plenty of money in the industry to do that - that was interesting to me as a university person.

What should the federal government be doing -the federal government we felt should be doing some serious coordination right across the country. They should be involved in the trade and marketing
aspects of environment as was talked about earlier this afternoon.

Priority actions required by the various groups - we certainly were encouraged by the pro-active approach of the pork producers and we felt that other producer groups should get pro-active in the same way developing industry wide guidelines, encouraging peer inspections, peer advice and so on. We thought these actions were very positive and should be copied by other groups that aren't yet doing so. I think I covered basically the actions that we wanted the federal and provincial governments to take, and that leads me to the last point - the top two follow-up actions recommended:

1. that the provinces must clearly define the municipal role in planning and siting, and that is basically to get over this problem where different municipalities have different requirements and interpret guidelines in different ways, or are subject to or swayed by local political pressures and so on - there has got to be some commonality.

2. that the provinces must insure that adequate environmental standards and criteria are applied and enforced. In order to do this, we felt that a mechanism is required to facilitate communications between all the parties involved - the governments, the industries and so on - to achieve better coordination on things like guidelines, on education, on sharing resources, on the environment evaluation criteria and so on. We felt that this was a rather key element and reflected on the whole issue - unless people are communicating we can't get anywhere; all the groups involved have to establish some effective mechanism for communication.

RESPONSE B

Basically what our group decided to do was to identify the main points emanating from the first part of the question, that is what impacts are land use planning, legal implications and various policies going to have on-siting facilities. The group had a consensus on two things, one being negative, the other one being positive. The negative aspect would be the limitation on expansion or establishment of operations - if there is a plan, you may be included or excluded. The positive aspect was that clear guidelines would reduce uncertainty and potential legal action, which seems to be similar to what Dr. Leonard just presented. The second part of the question, concerned what directions various government levels -- federal, provincial, municipal -- should be taking. We agreed that there should be uniformity between municipal, provincial and federal government policies or guidelines. It appears, that this is similar to the point just presented concerning discrepancies between one area and another - uniformity should be pursued. Another effort governments should make is in the area of awareness education concerning large livestock operations. This would be in regard to odours, relations with neighbours, and manure application and management.

Basically to answer the question regarding what are the priority actions required of various groups - federal, provincial, producers or other - we felt priority should be given to establishing clear policies, and ensuring that policies are adhered to and communicated. The second priority would be to monitor large livestock facilities for water and air quality, and effects on environment. I guess some of our uncertainty concerns determining what is the real effect of large versus small production units given the fact that there might be large operations that may have a better environmental status than some small units and vice-versa. This is an uncertainty that our group identified.

QUESTION 2

What will the trend be in operations in the near future?

1. Size (animal units)?
2. Location (near, urban, remote)?
Roadblocks (e.g. disease, neighbours, regulations, economies).

Most pressing needs (3-4).

Where possible, consider the above in relation to specific commodities (swine, poultry, dairy and beef).

Top two or three follow-up actions to be recommended from this group.

RESPONSE A

I always find it frustrating with tasks like these in that we could go on for a day and maybe get through only half the questions. It's also a little embarrassing to stand up here and read that question now knowing what I'm about to present does not necessarily address the question. Size of operation will increase -- we all agreed to that -- and we also agreed as we have heard this morning that the size will be limited by environmental considerations. One of the things we did discuss was the potential for small operations and there were two trends of thoughts on this issue. Using the example of swine in Ontario we are now moving towards three-site production which at least initially had the likelihood that it was not going to necessarily get larger, but rather it was going to spread out the swine production. Because by definition, rather than having a large farrow-to-finish operation on one site, we will be breaking it into its basic parts if you will, into farrowing, weaning and finishing units which will be on three different sites. In Ontario at the present time there is this trend to three-site production but the three sites are on an individual farm. They are still relatively small and this has the potential of spreading that manure around. The contradiction to this was a person from Manitoba who suggested that they are just starting to move into three-site production and rather than having a thousand-hog finishing barn that we see being built in Ontario, they are already starting at 4,000-hog finishing barns. So this may be a short term thing in Ontario, and by going to the three-site production, in fact at the end of the day we may end up having swine concentrated on sites.

Broilers and poultry expansion as well as dairy expansion will be limited by domestic consumption at least for the near term given supply management. But that doesn't mean that there won't be any of these challenges to expansion or at least concentration because there may be significant shifts. Somebody suggested the possibility of the poultry industry moving to Saskatchewan, so there could be moves within Canada and relocations which will still have an impact on specific areas or regions. Certainly with beef and swine there could be larger expansions to supply international and overseas markets. One of the interesting thoughts that came out in our discussion was that a major restraint to expansion will be "processing". I guess that is fairly obvious, but an issue that I haven't heard mentioned before is that processors may need an airport nearby. For an international processor, with meat going to Japan for example, proximity to an airport might be one of the reasons for selecting a processing site. Thus processing, and the location of the processor, could very well determine where expansion of the livestock operations will occur. Disease may have a limiting factor on size and particularly on location. I haven't heard a lot about this, but use the example of setting up a swine operation which is supposedly disease free and yet they don't have control of the land beyond their own fences, and that may be viewed as a restraint by some. They may feel that this is too much risk to take and prefer to have some sort of assurance that there won't be a livestock operation of a lower health status setting up near by. There was also a suggestion that there may be some concern in society that these large livestock operations have potential for disease transmission from livestock to humans. These concerns may be just red herrings; nonetheless they have been brought up from time to time. We got into the discussion of supply management and the argument was put forward that supply management has allowed environmental costs to be passed on. One
person suggested that to have a sustainable system, it must be economically viable, environmentally friendly and ethically acceptable. This is just a brief overview of some of the thoughts raised by our group concerning size of operations.

RESPONSE B

We had the same question as the previous group, but we took a slightly different approach to it and that's good. We got down to chatting numbers and as you can well imagine when you have representatives from across this vast country of ours and also our guest from the Netherlands we had a very wide variety of predictions as to where the various commodities would go size wise in the future. I'm not sure if the numbers really give us that much sense of direction and the other group probably took the better approach in saying "yes they're going to increase, the question is to what degree." Obviously the result is going to vary somewhat by region. Certainly if we look at the Niagara peninsula here in Ontario, there isn't any place for any more expansion and what might well happen in this area will be similar to that predicted for the Netherlands. The prediction is a 25% reduction in swine numbers in the Netherlands in the next five years or so.

Moving on then to factors that might affect location, there was a comment made about the need for good road access. In Ontario we are blessed with having good road systems, but certainly other parts of the country may not be as fortunate; thus quality of road system might dictate where these facilities go. A lot of discussion followed about how close operations might be to their market. It was felt that the poultry and the dairy industries would likely locate closer to urban centres and possibly the processing plants. Yet that tends to contradict what we heard a little earlier today about the cost of transportation. Maybe the need to locate near the markets and/or processing plants is more a perception and not a reality. A major factor concerning location was considered to be the non-farm rural population. Certainly I think all of us are very conscious of that issue. How do operators meet existing by-laws, let alone any additional, more stringent by-laws that may come into effect? There were two other issues related to location. If we see an increase in the use of composting as a means to handle our waste product, then there could be a problem to actually get those facilities located on the farm. As well, liquid manure and the various types of storages particularly earthen lagoons are problems to deal with in siting. We then looked at needs and actions that we should be pursuing and listed four from our group:

! There was a fair amount of interest in the approach that B.C. has taken in actually having areas designated for agricultural purposes only. Now whether or not that's achievable, it was suggested within the group that it is something that maybe we should be striving for.

! More positive promotion of our agricultural industry -- certainly there is still a lot of concern that we do not blow our own horn enough and make our consumer more aware of where their food actually does come from.

! Maintain our good disease control -- a concern was expressed that we might lose in our progress to expand. Certainly it is a big factor today in the poultry industry, and as well the swine industry, on the marketability of our product, and certainly a big factor in food safety.

! It was expressed that we really need to develop more uniform standards and policies regarding building permits, and the types of manure storages that are allowed, and where they are allowed.

QUESTION 3

In Canada what direction/approaches should be used in mitigating siting problems?

! Types of problems (e.g. odour, water quality, who was here first).
our group differed from others was the point that a lot of odour problems are between farmers and farmers, not necessarily between farmers and non-farmers. I think we have to recognize that farmers are a small percentage of the overall population and a small percentage of the rural population, but intensive livestock producers are a very small percentage of farmers; in nearly all jurisdictions they are a very tiny minority. Where we have a lot of problems is between farmers who don’t have intensive livestock and farmers who do have intensive livestock, and there is certainly some difficulty there. Beyond odour then of course we run into some of the other siting problems dealing with surface discharge of runoff from livestock facilities and manure storages. A third thing would be effects on ground water quality as a result of certain livestock practices. The point was raised in our group of air quality as a separate issue from odour. The air quality issue concerns some of these nitrogen based gases that come out of barns, and are given off by manure that can cause acid rain and various other problems. In that respect it really is a separate issue as compared to odour. Odour is a nuisance but some of these operations can have an negative impact on air quality and we asked “how is that a siting problem?” - well, it depends on which direction you live with respect to the wind and the rain. Someone made the point that there are areas of England where rainfall introduces more nitrogen into the soil than crops can use, so certainly it can be a problem. Another thing was the timing of not just field operations but all operations related to a livestock facility. Trucks moving, bringing livestock, bringing feed, hauling manure to fields, when the manure is placed on the fields - very often timing of these operations can be quite a concern and a problem for the neighbours. We looked at solutions to these problems and quickly one of the people in our group suggested, and we all agreed, that really what we're looking at are almost two separate streams of problems -- social problems and technical problems. And of course the solutions to the two will be somewhat different. For the social aspect of these operations, we

**RESPONSE A**

The first thing that was made clear by our group, and there was consensus, was that there should be guidelines versus regulations, and this is in order to stay out of court. Another thing for which there was consensus was, that there should be a national process that is made simple, and that would be used by owners to present their projects. This would help to have uniformity across Canada used in somewhat the same way as the National Building Code. These guidelines or process would be used by council during assessment. One point that was made in our group was that these guidelines should be developed based on sound scientific information. The role of the province would be to provide assistance to municipalities in implementing this process, and to coordinate in situations where you may have a water shed that crosses municipality boundaries. Concerning existing problems, one important point made was that there should be more public education, since often there may be problems that are perhaps perceived but are not necessarily real. It was even suggested that the school system could start educating the young people regarding the effects of farming.

**RESPONSE B**

When asked to be a facilitator I was told that I would have to remain neutral and since that's not my nature, I quickly volunteered since then I could express dissenting opinions while I was up here. We spent a fair bit of time initially dealing with the nature of the problem. We thought that in the process the first step would be to actually define the problems in the siting of these livestock operations and of course when you deal with livestock operations the first problem that comes up is odour; we've heard a lot of discussion about it today. One place where

---

**144**

---
saw a communication as a major benefit - communications between producers and regulatory agencies, the general public and neighbours. Listening to Jerry Friesen speaking today about people who inform neighbours about what they are doing with their manure practices and how they handle manure - I think that communication and understanding leads to greater acceptance. We saw that as a very significant factor in solving problems. Secondly, we saw separation distances as really a social solution rather than a technical solution. We are separating operations more to appease neighbours than because it's really going to have a huge impact on the odour. The suggestion was made that one of the problems we run into with separation is that you're often hiding the problem rather than solving the problem. To come up with separations that will satisfy people, you can get into separation distances in the order of three, four, five or more miles and that's really not a very feasible solution in most areas of the world. We also came up with the thought that deception was a social solution and the example used was planting trees around the feedlot; it didn't stop the odour but certainly people couldn't see the feedlot as well. Although deception may not be politically correct, we did see it as a possible solution. People have mentioned today perception, and Tim Ball of the University of Winnipeg has made the comment that perception is reality, facts are negotiable, and I think the O.J. Simpson trial is proving that.

Technical solutions - we looked at, first of all the idea of considering the value of nutrients, and using nitrogen phosphorus balances in evaluating livestock operations instead of just how much manure can be applied to soil, and what steps can be taken in the operation itself to reduce the amount of nutrients produced by the operation. Certainly in some parts of the world, progress is being made with respect to nutrition and genetics so that one can actually reduce the level of nutrients the operation is producing, thus nutrient balance is certainly a possible solution. Someone in the group made the point that many producers are not adopting generally accepted good practices, and in fact there is quite a large number of producers who are not even taking some of the steps that the industry views as being reasonable and generally acceptable. Thus there is a need for more education and possibly regulation in that area. Certainly in terms of technical solutions, there are things that can be done concerning manure storage and handling, such as covering manure storages, aeration of manure, and various other treatments. Also the use of buffers around water courses can be considered part of a solution. There is a need for reasonably priced equipment that will allow the injection of manure to work in conservation tillage crop production regimes.

Finally we came up with three actions that we consider to be critical. First, any programs and activities in this area needed to be clearly focused and targeted because in that way you're able to measure results. There is a need for a specific time frame for a program, and we thought even in these times of government restraints that there would be the possibility of some funding being available as long as there were clear targets and the money was addressing major programs. We came up with planning on quite a large scale but saw the need for better planning by producers, regulatory agencies and advisory groups as well. Planning both for the short term and the long term on these operations is necessary. We can't consider these livestock operations in isolation and assume that somehow you'll be able to get enough water and be able to deal with all the nutrients without affecting other water bodies. We have to look at a broader base and make sure that the livestock operations themselves are able to work in coordination with the land use and the water use in the area.

We had a couple of people from universities in our group, so of course we suggested that there was a need for more research on this area of improved management. We're looking at not just manure application, but the whole idea of managing the nutrients from these operations.
SESSION TWO

QUESTION 1

Biotechnologies (to tail of animal)

Identify some that are helping (relate to technology and commodity).
Some low risk that require more effort
Some high risk that require more effort.
Overall potential impact on mitigation of problems.

In each case highlight the top two/three items.

RESPONSE A

Our group addressed the question concerning biotechnologies involved "to the tail" of the animal. In other words, we were looking basically at the animal and the nutrition side of the equation. This was interesting since our group was primarily made up of agricultural engineers who are really not in the field of animal nutrition. However, we did have some comments. We were asked to identify some of the biotechnologies that are helping, what the risk level is, where we require more effort, and what would the overall potential impact be on mitigation of problems in siting or reducing conflict between existing facilities and neighbours -- where could biotechnology help? We felt that there has been ongoing work in this area for some time, and that it should continue. The amino acids that are used in various feed formulations, and now more recently specific proteins that are being added, could have potential benefits. We feel that related work should continue. Canola was mentioned as being a feed that has a high by-pass value in ruminants, and therefore can be very helpful in getting more utilization out of that kind of feed. We should be looking at other feeds that have that same kind of capability or potential. There are other things that we are doing with proteins such as heat treating, or treating with formaldehyde. We understand from an animal scientist that we did have in the group, that this is a new procedure that may lend some help in the future. There was an interesting comment from our friends in Western Canada about water quality suggesting that, in fact, water is a nutrient. That has some real potential that may be a lot of us take for granted -- how efficiently an animal can perform. In particular, high sulphate waters have been creating some problems in Western Canada. More research effort is required with all of these types of biotechnologies in feeding. Certainly we would like to see more tech- transfer on the value of some of these that are being used, such as Yucca plant derivatives, and other commercial products, just how much do they reduce the products excreted and do they help with odour control. Has there really been proper independent university testing done on these products? Certainly we know that those products are commercially available and are being used by various farmers, and being sold by various feed companies. We are really pleased to see some of the work presented this morning on phytase and other products that can reduce the amount of phosphorus excreted; certainly we feel that there is a lot more work to be done and in fact, a member of our group from the poultry industry was suggesting that he feels that the bigger problem with manure in the poultry industry is excess phosphorus as opposed to nitrogen. A researcher in our group in the nutrition area was very interested in seeing more effort being expended related to ruminants in comparing total roughage diets vs grain diets, not only for the amount of manure output and its composition, but also considering economics. Of course we have to tie in economics because with any of these scenarios, we are looking for good feed efficiency as well as the lowest cost of production that is possible. In that regard, we are suggesting while we want to see feed efficiency research continue, maybe we have to be aware of the fact of that, yes we do have an environmental responsibility to reduce the N, P and K by-products, but not forget about the bottom line for the farmer in terms of an economic feed for that enterprise. There was some concern expressed in our group about approvals. We don't necessarily have access to all of the various feed additives.
and other products that other parts of the world and particularly the USA have available to them. Fly-control products in the poultry industry were particularly mentioned, as were other pesticides sprays and some feed additives. This may be an area where we require a better approval process or more effort to justify why we can’t use them. If in fact there is a true health hazard that has to be proven so that concerns can be dispelled. There also was a big concern expressed about these various biotechnologies and public perception. The feeling was that we have been able to make some great strides with the various protein additives and the like, and yet we can look at a couple of particular ones, when we didn’t call them additives or derivatives. For example, we came up with this term for BST as "hormone". All of a sudden there was a great outcry from the public -- the consumer and so we have to be very careful. Obviously the public will find out things. They should be aware of what kinds of things we are doing, but we need to be able to have this kind of product, and so we need to be conscious of how it is perceived in the public. We want to know the overall potential for helping existing problem situations -- we know that it will be positive -- the question is to what extent. There is likely some other technologies that are going to be more useful in mitigating problem situations with neighbours who are already too close, but we should still be aware that we have the potential to reduce our by-products and therefore, should have the potential to reduce odours. The bottom line the group felt was that we have to have this technology to insure survival.

RESPONSE B

I think we had the same problem the former group did. There were several engineers in our group and generally engineers don’t know much in detail about rations and biotechnology affect animals. Perhaps this is why we ended up with some of the same ideas as the previous group. Some of the biotechnologies that are improving animal efficiency concern ration formulation and nutrient balancing. A lot of the genetic improvements are helping make our animals more efficient which will reduce the need for, and use of many implants and injections.

Low risk R and D: we thought of the same thing the previous group talked about - that is simple water analysis to determine for example sulphate levels. Another was further improvements in nutrient management. We were asked to consider big operations but I believe the big operations will be able to handle nutrient management technology because they may have appropriate people on staff or access to such expertise. We may run into more problems with smaller operations that may not have the capability to have rations formulated, and this could give big operations a bad name. I think this is an area that needs some work.

Education concerning biotechnology - I think many of the large hog operations have adopted a lot of this improved technology but when you call it biotechnology, the public's immediate reaction is "oh! this is terrible". I think the technology has to be better explained to them, and I think we have to be part of this public education process. New operations being established have to explain to the concerned public what biotechnology they are using and how it is helping them, and how it's not something to fear. I think there may be some barriers to adoption of some biotechnology, and maybe there is a need to look at some of these things at the policy level to see if there are barriers, and if they could be removed in order to facilitate adoption of biotechnology improvements.

High risk R and D: we asked what high risk meant and were told that it was research where we may not see light at the end of the tunnel, but feel there is a potential for significant improvements - it's something we should "take a shot at". In this perspective, somebody suggested that what we really needed was a "silver bullet" that would make manure smell nice - this would be an ultimate goal.
I believe there's some concern that some of this biotechnology may exceed the operator's management ability. Somebody mentioned the example of BST where you need superior management concerning nutrition to make BST function for you properly. From another perspective, we thought maybe it wasn't the animals at fault but rather the plant scientist who should be breeding a plant that has a better amino acid balance so that we don't have to do anything to the ration; then we could just feed the plant as it comes from the field. There may be some work that could be done in the plant technology area that could help.

Regarding overall potential impact: we agreed that biotechnology would have an impact but we weren't sure what the impact would be. I think the conclusion was that biotechnology will have a big impact on the total picture but the impact within the animal may be just a very small portion of that; there may be more potential for biotechnology benefits in the manure treatment area rather than in the animal itself.

QUESTION 2

Engineering Technologies

| Identify some that are helping (relate to technology and commodity). |
| Some low risk that require more effort |
| Some high risk that require more effort. |
| Overall potential impact on mitigation of problems. |

In each case highlight the top two/three items.

RESPONSE A

The question our group had to deal was engineering technologies. I thought this was going to be an easy one because I'm involved with engineering technologies being an engineer as opposed to, for example, a lawyer but as we got more into the question, I thought it became more confusing. The first thing that we were to do was identify some technologies that are helping, some where related R and D were low risk but require more effort, some approaches that are high risk but require more effort, and lastly overall potential impact on mitigation of problems. We chose to list all the technologies that we thought would be appropriate. We then looked at all these technologies noted that they are all existing technologies, but some require more research and development than others; as well, some might be economical and others might not depending on the situation. We then considered their overall potential impact on mitigating problems and categorized them. Thus our results might not be in the format of the original question put to us but here they are.

The first group included technologies that we felt have high potential impact for mitigation. The first item mentioned was the use of a straw or peat cover to cut down odours, and the next was the use of additives to the manure, again for odour control. Also discussed were feed additives to help control odour. Regarding the latter, some felt that more research is required since although there are some indications that there's quite good potential for this technology, the issue has not been adequately researched and documented. There's also the question of any other effects of the additives on the manure once it's produced. Again the comment was made that there was insufficient research and documentation to identify an effective product. Another technology that we talked about was composting. It was felt that this had a high potential for benefit. An example of a biofilter was the use of trees to surround part of the manure storage. The trees keep the storage "out of sight, out of mind", and as well someone in the group stated that there can be some actual absorption by the trees of some of gases. Another technique mentioned concerned off-farm application in cases where there may not be enough land to apply the manure, or it is in a sensitive area. The manure could possibly be dried, concentrated, and hauled and applied to areas such as forest where nutrients are required. And the last technology was the use of wetlands, however this would not be a panacea for all problems since you would have to harvest at some point, otherwise problems
with potassium accumulation could occur.

We could have used more time to discuss and categorize the technologies and their R and D risks into high, medium and low groups, but in spite of this we did some ranking. In the medium risk group, we considered manure injection, anaerobic digestion, static pile passive aeration (basically I would consider this as composting inside the building), and bioscrubbers. Someone made the comment that peat-moss (as a biofilter) is a nonrenewable resources, thus it might not be accepted publicly; alternatively, the use of sawdust was mentioned. The proper design of manure storages, and more research to develop technology to make storages more leak-proof were also identified.

In the group related to low risk, we included surface application using a pipeline system whereby you use a pipeline to bring the manure from the production facilities to the field. This would get tankers off the road as well as out of sight of the public. A satellite storage located near the application area could also be used. There was some mention of research being done now concerning ambient temperature vs high temperature anaerobic digestion; this is important for a country such as Canada where we have a very cold climate, however it has to be determined if it is economically or technically feasible. Another item mentioned was use of "dilution chimneys". In Europe there is apparently some regulation whereby exhaust fans must exhaust above a certain height. The reason for this was to dilute the gases exhausted before they reached the nearest neighbourhood.

**RESPONSE B**

Being an agricultural engineer, I started rolling up my sleeves and getting my calculator out when we hit this question concerning engineering technology but when we got into it, we took a different view and that might be because we had fewer engineers than other groups -- we'll see. Basically the main premise we considered was "to avoid expensive and sophisticated technology". How can we do that using a system's approach? Why don't we try to minimize how much technology we've put into these systems? On a regional basis you may consider non-point sources of nutrients in the watershed as not being treated on the farm but rather on a watershed basis. One thought was to possibly have constructed wetlands downstream where everybody in the watershed pays for its maintenance and everything from the watershed or a part of the watershed is treated, not just one operation. Another thought was to consider multiple objectives, including economics and environment, when planning or locating a site. This would likely result in meetings of all players to really look at the whole picture. More and improved planning coordination was also suggested. This morning we talked about having a map showing where and how much nitrogen was being used, and where the nitrogen was being produced. This could result in planning on a township or a provincial basis regarding where we might locate large livestock operations. If the proposed site was located outside a high population density area, and that area needed nitrogen, then you wouldn't impose the same sort of controls or technology compared to for example being adjacent to Toronto or Ottawa.

When we consider nutrient management, we need to look at the whole picture and not just one piece of technology. Likewise with solid-liquid separation, we are basically saying solid manure is good but how do we do this economically. Maybe we should be looking at separating not in the barn storage, but rather right at the cow or pig; certainly there is a different NPK ratio in the urine and faeces. Maybe there is room for some improved technology in this area. In considering the benefits and risks of composting, it's very "green" to be recommending composting but there are down sides as well. One must consider the overall nutrient balance including what is being released into the air, or surface or groundwater particularly if the compost is not covered. Just because something feels morally
good, you need to look at the whole system to see if it really is. Constructed wetlands possibly on a watershed basis may be useful. Large operations could be initiated, whereby the use of constructed wetlands, with its increase in natural habitat for wildlife, could offset some of the potential negatives of the large operation.

We also felt that the systems approach could assist to ensure that we had a level playing field for example between Texas, North Carolina, California, Alberta or Ontario otherwise we could have concentrations of large livestock operations moving all over simply because of local regulations. It would be useful if there was some type of overall environmental product standard. There was a big debate in our group as to whether we us the carrot or the stick; do we give incentives or regulate, and then who pays? One comment made was that tax payers don't want increased taxes, but they may be willing to pay more for their food, for example if it is "green" produce.

QUESTION 3

Nutrient Management (after tail of animal)

Should nutrient flow schemes be suggested / required?

How to implement?

Who to administer?

Actions (policy, regulation, etc.) needed to improve positive impact of nutrient management programs.

RESPONSE A

Our group was asked to consider nutrient management after the nutrients had left the animal. We were to consider for example whether nutrient flow schemes should be suggested or required first of all, and then how should they be implemented, who should administer the program, and what are some possible actions required. First of all, our group decided that we don't want to use the big stick approach just yet, or possibly ever. The feeling was that there are other people standing by if necessary with their big sticks if things do go wrong. We are saying that nutrient management plans are a necessity but that they shouldn't be regulated. We should try to do our best to deal with these nutrients on our own. Producers should be very much involved in this type of thing and hopefully dealing with it in an acceptable manner well before the Ministry of Environment or someone else like this has to come along to impose regulations. As far as implementation is concerned, we feel education is a rather major part of the whole process. Here we are talking about recommended Best Management Practices, possibly provincially administered programs such as Ontario's Environmental Farm Plan where the farmer is very much involved in that whole process, and as well some sort of a peer review committee. A comment that was made was that maybe there should be a requirement for something like this tied to the building permit process.

Regarding recommended actions, first and foremost we felt that it was important for the owner to be involved in record keeping, since I believe that if there are difficulties arising, there would be some sort of a historical background of the situation and what is taking place, and how that person has been dealing with the circumstance. One of the interesting things that we discussed was the recognition aspect. We talked about the possibility of some sort of a peer review, or a program that would involve government, producer groups, and agribusiness for example that would offer a farmer recognition possibly in the form of a nice sign or something like that could be placed out at the gate indicating that this person has gone through this process and is in fact doing a good job of dealing with their nutrients. This approach could be expanded beyond just nutrient management as well.

As far as education is concerned, we talked about developing materials that could possibly be an added to the Environmental Farm Plan, or the potential for developing 4-H programs or something like this to get younger people involved in understanding the need for nutrient
management. As well, there was a bit of concern that possibly some of the financial institutions don't have the type of expertise they should have regarding the issue of nutrient management, and that perhaps injecting a bit of appropriate education into that area would be beneficial. We felt strongly that coordination was necessary so that the farmer will not be constantly harassed by people looking for additional bits of information; this whole process must be coordinated so that for example the banks and various other people aren't asking for different or overlapping nutrient management plans. This must be coordinated to avoid a lot of overlap. Finally, we felt that there must be an acceptable equilibrium between requirements and voluntary actions. This is something our group considered to be very important; that there be a balance between the two.

RESPONSE B

Keeping our group on track was like trying to walk a Labrador retriever through a room full of squirrels. And the reason that we got off track was, in my view, the talk earlier by Rob Janzen and his idea of having a regional approach to manure management. This got us thinking in that direction as opposed to a nutrient management plan for individual operations. We did try to answer the questions posed to us. Should a nutrient management plan be required? -- I guess the answer was yes. Probably the overall purpose that we saw for such a plan was, in the short term, to educate farmers. The long term goal would be to develop a regional manure plan; thus before a regional plan can be developed, we need a farm population educated in this fashion. A second reason for requiring such a plan would be for the immediate concern of society. The planner from Huron County suggested that we need to do something in the short term because of the rapid expansion of these very large operations, and we're going to have to do something to satisfy society's demands that we are taking care of our manure. This is another strong argument for nutrient management plans. As I noted already, it's not the total solution in the long term, but particularly for the larger operations, a regional plan is something that's going to allow them to do something else with their manure especially in conjunction with, for example, fertilizer companies.

How to implement nutrient management plans - One approach mentioned was the environmental farm plan approach which should be a voluntary exercise by farmers. A second approach might be to tie the plan to building permits in which case there would be certain cut-offs based on the size of the operation, with the larger operations requiring a plan. As well, if they didn't have enough land on which to spread manure, the nutrient management plan would kick in. Our group understood that we were to talk about only the large operations but certainly it's the small operations, and we heard this yesterday, that may be the biggest culprits here, or at least have the potential for being the biggest culprits as far as pollution is concerned. Thus it doesn't necessarily deal with the problem entirely if we only target large operations.

The administration of a nutrient management plan -- It was suggested by someone that if this is going to be a government program, we must understand that government dollars are limited. And if it's going to be a requirement, and require a lot of follow-up to ensure people are following these plans, then I don't think those dollars exist now-a-days. Again, going back to our earlier point, regional schemes are going to be a better long term solution. And a possible action that we identified was to explore some of these regional schemes, and involve other players such as the fertilizer industry.
PANEL DISCUSSION - OPENING COMMENTS INTENSIVE LIVESTOCK SITINGS
DRIVING FORCES FOR CHANGE

Dr. Gord Surgeoner
University of Guelph Guelph, Ontario

Professor, Dept of Environmental Biology, U of Guelph
Chair, Working Group that developed Our Farm Environmental Agenda and Environmental Farm Plans
Current research responsibilities in Medical - Veterinary Entomology

FORCES OF CHANGE

In analysing the need for intensive large-scale livestock facilities, I am reminded of the quote from the Pogo cartoon, "We have seen the enemy and he is us".

The driving forces causing change in agriculture are:

1. **Human Population Growth**: It is estimated that the human population will double in the next 40 years from 5.7 billion to 11-14 billion. This doubling of population is also predicted for Ontario with 223,000 more people per year (Ontario Soil, Water and Air, OASCC, 1994). PETA (1995) has estimated the number of animals each North American eats in their lifetime, Table 1. I hasten to add that some consider this a significant overestimate (see OFAC 1995) of animal consumption. Irrespective, society in North America will need almost double the current production within 40 years if diets remain the same.

Table 1. North American lifetime consumption per person of animals.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs</td>
<td>43</td>
</tr>
<tr>
<td>Cows</td>
<td>11</td>
</tr>
<tr>
<td>Chickens</td>
<td>1107</td>
</tr>
<tr>
<td>Turkeys</td>
<td>45</td>
</tr>
<tr>
<td>Lambs</td>
<td>3</td>
</tr>
<tr>
<td>Fish</td>
<td>861</td>
</tr>
</tbody>
</table>

PETA 1995

2. **Environmental Concerns Related to Agriculture**: As we place more people into a limited space, environmental concerns will only increase. Although legislative protection to the farmer exists for noise, dust and odours such things as stream sedimentation and ground water contamination are areas where we must do a better job. Recent well surveys, in Ontario, indicate ca. one-third of Ontario farm wells do not meet legal standards relative to nitrates or coliform bacteria. Is agriculture adversely affecting, the wells of rural non-farm farmers who constitute the majority of the rural population? We better not be! Issues extend beyond safety but
rather to trespass. Would you drink water with 1 ppm of faeces or urine even if it were determined to be safe? An additional point to recognize is that "most shoppers" are not environmentalists. They buy on the basis of quality, price and convenience with the environment being low or a non-existent priority. Foodland Ontario is well recognized but consumers will only pay a 3-4% differential to support Ontario farmers, I suspect support of the environment is the same.

3. The Government is Broke: Recent budget realities, federally and in Ontario, demonstrate this. Importantly, policy can be affected by sticks (laws and prosecution) or incentives (society pays for action). The ability to use incentives has gone or been decreased markedly. In fact, as the pendulum of change swings, my concern is that we may see ghettoization of agriculture and industry, i.e. site of large farms in the province that has the least stringent standards and enforcement. This will affect the whole country.

4. Globalization: The global village is now. It reflects global competition in the agriculture industry. All one has to do is walk into a grocery store and see the countries represented or read the papers on GATT, NAFTA, etc. Importantly, for the purposes of this Conference, "public opinion" is shaped by global events. If NBC, CBS, ABC show massive fish kills because of hog manure in North Carolina then siting becomes an issue in Ontario even if our laws were significantly different. Canadian public opinion of the "justice system" is being formed as they watch the O.J. Simpson trial.

5. Technologies: We have heard considerable detail about biotechnology and its role in reducing impacts. The other technology shaping agriculture is microelectronics (Satellite Precision Farming). One of the driving keys to change is that technologies are not management neutral. Generally, you have to be a much better manager, part-time farmers often cannot use certain technologies. As was indicated earlier, intensive agriculture will require well educated, dedicated individuals. Importantly, technologies, e.g. engineering solutions are often not size-neutral but rather the only way you can pay for them is on a large production scale. These factors encourage large sitings.

6. The last driving factor is that the competition for plant material for non-food, non-animal feed will increase dramatically, e.g. plants grown for plastics. This will compete against animal feeds again ensuring better management of animals and better nutrition.

"If you don't know where you are going, any road will get you there". The Wizard of Oz.

This reflects a fundamental question of what is the role of agriculture. To produce safe, nutritious food at a reasonable cost. If this were the case, we have done a great job. A food basket of 1 lb of pork, chicken, beef, butter, cheese, potatoes, apples, oranges, flour, rice, coffee and 1 qt of milk, cooking oil and 1 doz eggs requires the following "average" labour time

<table>
<thead>
<tr>
<th>Location</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ottawa</td>
<td>2 hrs and 31 min</td>
</tr>
<tr>
<td>Washington</td>
<td>2 hrs and 36 min</td>
</tr>
<tr>
<td>Tokyo</td>
<td>4 hrs and 57 mini</td>
</tr>
<tr>
<td>Pretoria</td>
<td>7 hrs and 35 min</td>
</tr>
</tbody>
</table>

If our objective is to preserve farmers we have done a terrible job.

In 1921, there were 139,000 hog farms in this province; by 1991, 8,940 and this number has shrunk dramatically since 1991. All commodities show this trend because of specialization and larger farm sizes.

How Did We Meet Societies Needs Over the Past 40 Years?

How agriculture in Ontario has changed to meet
the needs of Ontario society has been published in a series of articles. The articles are on a sustainable agriculture system (Surgeoner, 1993), the improvements in the poultry industry (Surgeoner and Leeson, 1993) swine industry (Surgeoner and Dalrymple, 1993) and the dairy industry (Surgeoner and Grieve, 1994). I will use the poultry industry to illustrate what has happened in Ontario.

In 1951, there were 4.6 million people in the province; by 1991 there were 10.1 million (a doubling in 40 years). We can expect that the population will double in the next 40 years. The demand for poultry products are outlined in Table 2. The changes that took place in the egg industry are in Table 3 and the broiler industry in Table 4. Major advances include the genetics of the bird, 3.4 kg of feed per doz eggs in 1951 vs 1.6 kg in 1991; 6 kg of feed for 1 kg of bird in 1951 vs 1.85 kg in 1991. Similarly, on the cropping side, in 1951 we obtained 3.4 T of corn per ha vs 6.9 T in 1991; soybeans improved from 1.6 T per ha to 2.4 T per hectare. These improvements, plus better health protection, have allowed for significant savings of land (Table 5). In agriculture, we often speak of increased productivity but we should emphasize less resources required to produce the same amount of product. In this analysis, we looked at land. Swanton and Clements, 1994, have similarly analyzed the use of fossil fuel in crop production showing a major decrease in diesel fuel per tonne of corn (88 L per T in 1975 vs 36 L per T in 1991). This is primarily from better genetics and management, i.e. increased yield with the same nitrogen inputs. Similarly, birds used to generate 7.14 kg manure per doz eggs and 12.60 kg manure per kilogram of chicken; these values have dropped to 3.36 kg manure for eggs and 3.88 kg manure for meat. Finally, we can consider issues like free range chickens, this but to meet the demands for Ontario would require 50,000 additional hectares. Where is this land to come from?

Table 2. Ontario demand for poultry products from 1951-1991.

<table>
<thead>
<tr>
<th></th>
<th>1951</th>
<th>1991</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>4.6 M</td>
<td>10.1 M</td>
</tr>
<tr>
<td>No. of Eggs</td>
<td>107 M doz</td>
<td>179.2 M doz</td>
</tr>
<tr>
<td>No. of kg/meat</td>
<td>45 M kg</td>
<td>299 M kg</td>
</tr>
</tbody>
</table>

The point is as the demand for food increases dramatically we have three options: 1) eat less, 2) increase land in agriculture, and 3) produce more food with fewer resources. The choice can be a combination of all, but Option 3 has been the primary method of achieving this goal and appears at least for the next 40 years the option most likely to meet societal demands.

Table 3. Ontario land required to produce eggs from 1951-1991.

<table>
<thead>
<tr>
<th></th>
<th>1951</th>
<th>1991</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Eggs</td>
<td>107 M doz</td>
<td>179.2 M doz</td>
</tr>
<tr>
<td>Feed Efficiency</td>
<td>3.4 kg/doz</td>
<td>1.6 kg/doz</td>
</tr>
<tr>
<td><strong>Tonnes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>218,280</td>
<td>172,020</td>
</tr>
<tr>
<td>Soybean</td>
<td>109,140</td>
<td>86,016</td>
</tr>
<tr>
<td><strong>Yield</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>3.4 T/ha</td>
<td>6.9 T/ha</td>
</tr>
<tr>
<td>Soybean</td>
<td>1.67 T/ha</td>
<td>2.4 T/ha</td>
</tr>
<tr>
<td><strong>Hectares</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>64,200</td>
<td>24,930</td>
</tr>
<tr>
<td>Soybean</td>
<td>64,300</td>
<td>35,840</td>
</tr>
<tr>
<td>Total</td>
<td>128,500</td>
<td>60,770</td>
</tr>
</tbody>
</table>

To meet 1991 demand:

using 1951 methods = 215,200 ha using 1991 methods = 60,770 ha area saved =
Table 4. Ontario land required to produce chicken meat from 1951-1991.

<table>
<thead>
<tr>
<th></th>
<th>1951</th>
<th>1991</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand</td>
<td>45 M kg</td>
<td>299 M kg</td>
</tr>
<tr>
<td>Feed Efficiency</td>
<td>6:1</td>
<td>1.85:1</td>
</tr>
<tr>
<td><strong>Tonnes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>162,000 T</td>
<td>332,000 T</td>
</tr>
<tr>
<td>Soybean</td>
<td>81,000 T</td>
<td>166,000 T</td>
</tr>
<tr>
<td><strong>Yield</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>3.4 T/ha</td>
<td>6.9 T/ha</td>
</tr>
<tr>
<td>Soybean</td>
<td>1.67 T/ha</td>
<td>2.4 T/ha</td>
</tr>
<tr>
<td><strong>Hectares</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>47,650</td>
<td>69,125</td>
</tr>
<tr>
<td>Soybean</td>
<td>48.500</td>
<td>48.101</td>
</tr>
<tr>
<td>Total</td>
<td>96150</td>
<td>117226</td>
</tr>
</tbody>
</table>

To meet 1991 demand using 1951 methods = 638,800 ha using 1991 methods = 117,226 ha area saved = 521,574 ha

Table 5. Total Ontario land saved by better poultry and crop efficiencies, 1951-1991.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Broilers</td>
<td>521,574 ha</td>
</tr>
<tr>
<td>Layers</td>
<td>154,430 ha</td>
</tr>
<tr>
<td>Total</td>
<td>676,004 ha</td>
</tr>
</tbody>
</table>

676004 ha = 98.4 x area of Guelph

10.7 x Metro Toronto

The Real World Has Tradeoffs

In summary, mega-farms are often seen as bad because of their potential impact on the environment and the "small" farmer. As I have listened today, the question arises, Would society be better served by one large farm, with stringent codes of practice and quality management or by 200-300 smaller farms with a lot of the producer's time spent generating off-farm income?" From an education, management option, regulatory standpoint, the large farm has the greater potential for controls and use of available technology.

If we are to meet the needs of society, we will require more technology, better engineering and better managers and continue to push our frontiers of innovation through research. Finally, in Canada, in my opinion, we must have all provinces with the same environmental, health and animal welfare standards. The reputation of Canada and our agricultural products will be dependent not only on quality but to some extent on our codes of Page 10 - practice. You can be certain that if one province has lower standards, e.g. nitrate levels in water, this will get the media's attention and be the trade issue.

In the final analysis, it is not the size of the farm, the number of animals, etc. but the knowledge and management necessary to run these farms in an efficient and environmentally sound manner.

REFERENCES


Dr. Andy Manale
Environmental Protection Agency
Washington, USA

! A Senior Program Analyst in the Office of Policy, Planning and Evaluation of the US Environmental Protection Agency
! Manages Comprehensive Economic and Environmental Policy Evaluation System (CEEPES), an analytical system for geographic planning
! Under a German Marshall Fund Environmental Fellowship, examined the effectiveness of the European Community’s program for controlling animal waste

First before I say anything else, I would like to thank the Steering Committee for inviting me to this workshop. I think I have benefited probably far more from it than I think others may have learned from me. I say that in spite of the fact that over the past two days I’ve missed two days of the O.J. Simpson trial. I have however a couple of comments. Some of these comments simply emphasize or re-emphasize what other people have just presented including the last speaker, or else point out a few things that perhaps have not yet been considered. One thing I recommend is that, in all the policies and considerations that are taken in regard to siting, one perhaps ought to use as a measure whether or not these policies and technologies lead to an increased or positive value for manure. And I would say that if whatever we are doing leads to a positive or increased value for manure, then chances are we are probably going down the right road. If it leads to a negative or decreased value, then we are probably going in the wrong direction. In evaluating any policy for siting, try to go beyond consideration of simply an individual farm and look more broadly. Look at the impact of decisions from the perspective of the watershed or other appropriate geographic base unit. Another appropriate goal for siting is to try to. reintegrate the livestock industry with the crop production industry. The two sectors have been growing apart and we need to bring them back together perhaps at a higher level of organization. If there is an increased cost of any consideration or technology, one should also ask the question "Is the producer able to pass that cost on to the consumer?" If the producer is not able to pass on that cost, I think we also need to perhaps 1) reconsider that policy or that technology and 2) determine if there are other policies that may be necessary to level the playing field, such that the producer can do that. Concerning research, I suggest linking economic models with fate and transport models whereby you will have a better tool for evaluating options on a regional or a larger geographic basis. Consider also economies of scale. One technology such as a methane digestion facility, may not make economic sense for an individual farm, but perhaps it makes economic sense on a regional basis, or a facility that can shared by a number of producers. The same applies of course to other items such as a

Quite often with vertical integration, the individual producers have a great difficulty passing any costs onto consumers. The vertical integrator is a better position to do so. Furthermore, the task and cost of insuring compliance is a whole lot smaller at the level of the processor compared to having government try to enforce compliance of regulations on every individual producer; the latter is just too costly. Simply follow the principal of “who owns the animal should also take responsibility for any by-products of animal production”.

Something that was brought to my attention in the Netherlands in fact, is to think in terms of new products to be made out of manure. On the lighter side as an example, one product that is popular in the United States (you’ve heard of pet rocks, one of those ridiculous things that we produced in the United States) are pets that are made of manure. They are selling them now in various specialty shops. Not only is it cute on your desk, but if you get sick of it, simply throw it into your plant that you likely have in your office and it will fertilize the plant.

And finally, where you do have vertical integration, and it is my understanding that you are not as far along that road as is the United States, do consider ways of imposing more of the responsibility for environmental waste management on the processor rather than on the individual producer.

I understand Canada is having the same economic problems that the United States is having, therefore to the extent possible, consider economic approaches that do not depend on government cost sharing as the solution to the problem. You need to look more in terms of to what extent you get the consumer to ultimately pay for that benefit. One thing that Christine Nymark suggested that I think needs to be seriously considered is the whole notion of manure production rights. Perhaps in a watershed where there is an excess of manure that’s produced given the amount of land available, there should be a market in rights to produce this excess, so that over time you can ratchet down to reach a level of sustainability.

And finally, where you do have vertical integration, and it is my understanding that you are not as far along that road as is the United States, do consider ways of imposing more of the responsibility for environmental waste management on the processor rather than on the individual producer.
First of all I would like to say it's a pleasure for me to be here and to participate in this "Siting Workshop". Thanks for the opportunity to share some of my Dutch experiences with you. The workshop is in my opinion very interesting and well organized. Congratulations to the organizing committee.

Concerning siting large livestock and poultry operations, I would like to make the following comments:

During the first day of the workshop we heard several speakers saying: "we do not want to have problems with surpluses of manure like some European regions". They are right; preventing is better than solving problems. When you start new large scale operations, be sure that there are ample possibilities to dispose of the animal manure in appropriate ways.

Reducing odours by covering manure storages and better manure application techniques, will also reduce N-losses by ammonia volatilization to the atmosphere. Thus there will be more N available to apply on the fields. As well, the recovery of N from manure after injection is higher than after surface spreading. This means better manure handling, storage and application practices can help pay for themselves to a great extent.

Composting of animal manure will result in a better fertilizer and reduced transportation costs. However there are high losses, especially of N and C, during the composting process. The released gasses are called "greenhouse gasses". Be careful not to solve one environmental problem while causing another at the same time.

Pay careful attention to the prevention of disease. In the Netherlands, we have some municipalities with high numbers of medium sized pig and/or poultry farms close to each other. Although we have, in my opinion, a good system of animal disease control, we experienced last year a couple of outbreaks of epidemic diseases on pig and poultry farms. These outbreaks caused high economic losses through dead animals and slower growth rates as well as temporary restrictions of our exports.
Avoid creating a situation where more medications are used to prevent or cure diseases, otherwise you can expect new environmental problems due to residues of these medications, which in itself is a growing concern of consumers. They are asking more and more today for clean products, without additives and residues.

A mineral balance gives a good impression of the difference between nutrient inputs and outputs at farm level. It provides the farmer with good information about the main inputs of his operation, and outputs, and about the steps in the production process where the greatest revenue improvements may be expected due to mineral management on the farm.

Following this workshop my main conclusion is: altogether we have a lot of knowledge concerning knowledge of the basic environmental processes related to livestock farming. The challenge now is to integrate this knowledge into systems that are suitable and sustainable at the farm level. The exchange of information that occurred between the participants of this workshop brings this integration process a significant step forward.
Sally Rutherford  
Canadian Federation of Agriculture  
Ottawa, Ontario

Executive Director, Canadian Federation of Agric.  
Board member, Agric.-Food Competitiveness Council  
Member, Task Force: North American Wetlands Conservation Council  
CFA Rep. to Agric.. & Rural Restructuring Group  
Member: Agric.. Can. External Panel on Regulatory Review

There are a number of points which need to be taken into account as we move ahead and attempt to address the issue of animal operation siting.

Harmonization/Coordination: there must be political efforts to harmonize and coordinate requirements for animal operation siting; there must be some real effort at harmonizing and coordinating research and information availability in order to reduce duplicating of effort - it could be looked on as "work sharing" to reduce the jurisdictional tensions.

Look at issues as a package: we can't just address the issue of siting as a political issue or as a waste management issue. There are real opportunities to look at the problems from a "packaged" point of view and deal with as part of Best Management Practices systems or HACCP systems which will benefit the entire operation in the long run.

Research: we need new approaches to research not just how to get rid of smells and animal waste but what other uses could it be put to, how could feeds be altered to reduce the waste problem, etc.. There will inevitably be fewer research dollars so we will have to be more creative.

Communications: good communications with other farmers, consumers and government practices and progress is important. Silence is no longer always golden.

Bottom Line: solving the siting problems will likely result in direct costs to primary producers. It is important to turn the costs in to revenue generators and /or to find ways of passing the costs along the line.

Regulation vs Volunteer action: there is no doubt that most changes will happen most easily with the encouragement of volunteer action as opposed to the implementation of rigid regulations. The onus is on the industry to move ahead at a strong steady pace to address concerns with information and/or research and better practices in order to eliminate the need for government regulation.
Dave Hanly
Perth County, Planning and Development Stratford, Ontario

- Raised on an Ontario farm (mixed farming and mink)
- Worked in the planning profession since 1977 with Perth County Planning and Development office
- Currently Planning Director with that office
- Emphasis on urban/rural interactions

It is indeed a privilege to have been asked to attend this workshop and a pleasure to listen to and converse with the participants and registrants. While my work affords me the opportunity to attend workshops and the occasional conference, I have found this workshop to be particularly useful in obtaining new knowledge concerning issues associated with larger livestock and poultry operations.

As one of the few municipal planners present at this workshop, it is important that I provide you with some comment from the municipal planning perspective on what we have heard and learned over the last day and a half. At the outset, I must say that planners in my jurisdiction and neighbouring counties in South-western Ontario and our respective political masters have received the message—agricultural industry is experiencing the trend towards larger livestock and poultry operations and this trend will continue on into the future. Many of the new livestock and poultry operations introduced into my work area, Perth have been of the large-scale variety.

By way of background, local municipalities in the Province of Ontario and in other provinces throughout Canada are creatures of their respective provincial governments and receive certain powers from same. Their day to day activities, particularly in the area of land use planning, are focused on various laws and regulations enacted by provincial governments. The recently released Bill 163 initiatives of the Ontario Government and the British Columbia Government’s amendments to its Land Titles Act and Municipal Act are timely examples.

In Ontario, the principal planning tools, or documents used by local municipalities to address planning issues are the Official Plan and Zoning By-law. From a planning practitioners perspective, one of the basic purposes of these documents is to prevent and/or reduce land use conflicts and incompatibilities. While every local municipality has the authority to enact an Official Plan and
Zoning By-law and there is a generally accepted form as to the content of same. Official Plan and Zoning By-law documents will differ from one municipality to the next. Local municipal councils have the authority to formulate land use policies and Zoning By-law provisions to address the issues and problems of their respective municipality as they see them. Planning in Ontario operates within the Province’s political framework and as such is subject to a range of political processes. In Perth County, we are fortunate in that many of the planning regulations affecting the siting of livestock and poultry operations are consistent from one Township to the next. Such is not always the case throughout much of Ontario.

Some of the greatest issues and concerns involving large livestock and poultry operations are the generation of large amounts of manure, manure management practices, and the disposition of same. Most of the speakers at this workshop have acknowledged that "odour" is a primary concern to the industry and I can certainly confirm that the same opinion is held at the local political level. We have heard Dave Sands from the British Columbia Ministry of Agriculture and Food suggest that odour issues really boil down to "satisfying your neighbour". Based on my experience with manure issues associated with livestock and poultry operations in Perth County, I can agree that there is considerable truth in Dave’s suggestion. I can also say from first hand experience that some things change very little through time. As a young lad growing up and working on a mink farm in Blanshard Township in Perth County some 25 to 30 years ago, I can vividly recall my father impressing upon me the fundamental importance of taking neighbours into consideration and keeping them happy when it came to the spreading of mink manure on farm fields. While this may be a simplistic view of the problem, I am confident that adherence to this consideration would result in far fewer concerns over livestock and poultry manure in our respective parts of the country.

Concerns at the local municipal level over generation of large amounts of manure, manure management practices, and the disposition of same will continue to be significant and are not likely to be resolved quickly in the years to come. Local municipal concerns are justified given the potential for pollution associated with livestock and poultry operations. If the American experience as cited by Dr. Andy Manale is experienced in Canada, where livestock and poultry manure is generally considered as waste to be disposed of as cheaply as possible and where farm operators are taking the position that disposal of manure is not a primary concern to them, then I suggest that the farm community in Canada, local municipal councils, and their planning practitioners have much to be concerned about. Bob Robson’s observation that the land base in Canada is capable of supporting approximately 25 times more animals than are presently raised/produced in combination with Dr. Manale’s comments, are likely to cause great concerns at the local municipal level, as well as an array of planning regulations affecting the siting of large livestock and poultry operations.

In the formulation and drafting of municipal planning documents (Official Plans and Zoning By-laws), it is important that municipal councils and their planning advisors do not become "regulation crazy". Zoning By-law provisions pertaining to farm operations and the siting of livestock and poultry operations need to be crafted carefully to ensure that they are effective and necessary in order to achieve the desired end. It is important that municipalities, particularly those that are strong and supportive of agriculture and the agriculture industry and further convey a very positive attitude towards agriculture and the farm community. The example cited by Gerry Friesen yesterday afternoon where a local municipal council in the south-west corner of Manitoba had a very negative attitude towards and discouraged livestock and poultry operations at all cost needs to be avoided.

In preparing their planning documents, it is important that a local municipal council properly protect prime and productive farmland areas; limit growth of urban settlements through a
properly prepared growth management and settlement strategy; prohibit the establishment of non-farm users, including residential development, in agricultural areas; prohibit the creation of farm retirement lots and lots for sons, daughters, and hired hands; and prohibit or severely restrict the severance of surplus farm dwellings. While it may be difficult from the individual farmer's standpoint to accept the prohibition of severance for farm retirement lots and surplus farm dwellings, such is clearly necessary if we are serious in our attempts at reducing land use conflicts and incompatibilities. While we have listened to comments on the merit of Right to Farm legislation and Farm Practices Protection Boards, such legislation and boards are only a small part of the solution to deal effectively with land use conflicts and incompatibilities. A far bigger part of the solution is the prevention of the land use conflict and incompatibility in the first instance. In Perth County, most of our local municipalities moved to prevent the creation of residential lots and farm retirement lots in agricultural areas approximately two decades ago and these steps have proved useful in reducing the number of conflicts and incompatibilities between residential development and agricultural operations throughout the County. Similar steps taken by the neighbouring counties of Huron and Oxford and the neighbouring Regional Municipality of Waterloo have led to our particular part of Southern Ontario having some of the most restrictive severance policies in agricultural areas in Ontario.

The continued trend towards increased farm operation size also poses some interesting and challenging problems for local councils on the social front. As farm operations increase in size, local municipalities are likely to experience a decrease in their population base which in turn will have an impact on the ability of municipality to continue providing the basic level of government services demanded by its ratepayers (roads, landfill, recycling, schools, parks, and recreation uses). The private sector will also experience difficulties in maintaining the current level and providing new opportunities of commercial and employment opportunities in these local municipal areas. Further, the continued trend towards decreased farm population and increased non-farm population in rural municipalities gives rise to the potential for those rural municipalities to be dominated by non-farm interests. In addition, decreased population base and increased complexity of local municipal governments may result in lack of interest in filling council positions at the time of local municipal elections. Problems associated with these trends have been experienced in the past and are likely to continue on into the future.

Over the last day and a half, we heard that it is important that the farm community and agricultural industry lobby the provincial and federal levels in order to protect the best interests of the farm community and agricultural industry. I suggest to you that there is also a need for you to lobby effectively at the local municipal level. While our provincial governments will set the framework within which local municipalities must carry out their land use planning programs, it is the local municipal council that sets the zoning standards which building permit applications for livestock and poultry operations will either meet or fail to meet. It is also important to remember that the local municipal council level is generally more approachable and responsive in regard to land use planning issues.

Finally, I wish to conclude my comments by encouraging each and everyone of you to take the opportunity to be an effective participant in resolving planning problems at the local municipal level. The County Council and local councils that I work for are very appreciative of receiving input and feedback from the various agricultural groups operating within their political jurisdictions. The recent example of Perth County moving to establish an Agricultural Committee consisting of farm organization, commodity group, provincial agency, and local council officials to review and address various issues associated with livestock and poultry operations is seen as a very proactive step and one which is turning out to be very positive. Effective input from all stakeholders is an absolute must if we are to be successful in meeting the challenges facing agriculture on into the 21st century.
I speak in the first instance as a member of CSAE and a representative of the agricultural engineering community. However, it is difficult to sort out or to limit other influences on my interpretation of what has happened at this Workshop. I bring therefore some perspective as an agrologist, an engineer, a professor, a learner, a consumer, a rural non-farming resident, and a parent.

I didn't hear livestock producers, environmentalists, regulators and planners hurling accusations at each other. Perhaps that is because of rather limited participation in the Workshop by representatives of the latter three groups. However, more likely it appears that there is a real desire by livestock producers to live in harmony with their neighbors and the environment. Industry was unanimous in the desire that all its members do meet acceptable standards, not with an attitude of coming to the end of a losing fight but rather with an optimistic recognition that there might be something in it for the industry.

Although we heard from four corners of the industry on general problems and opportunities,

manure digesters just outside the biosecurity perimeter of a number of livestock operations and sells gas or other products back to the farms. Such a development could assist livestock producers who want to use processing technology but who don't want to invest in, or manage, that technology themselves.

On the regulatory side, it appears to me that, in general, regulations and standards in Canada are leaving room for local, farm specific, application of appropriate technology and systems. That is good. I would hope that our desire for "a level playing field" or a desire for quick and easy regulatory solutions, would not lead us unnecessarily to prescriptive standards that take away the incentive for individuals to be better managers or to implement better technology. In the building codes, we specify what a roof has to do (i.e., the loads it must support) but not how it must be built (i.e., trusses at 4 feet on centre). Hopefully we can have siting guidelines and regulations that, for example, specify allowable nutrient levels in soil and water rather than giving absolute loading limits. We need manure containment objectives rather than absolutes about what kind of tanks should be built. Site specific engineering of manure systems for larger livestock operations is a good alternative to non-optimized prescriptive standards.

I think we need to question how defensible our recommended separation distances are. That there should be buffer zones around intensive livestock operations is not in question. What is in question is how large those zones need to be and who should provide them. Recommended separation distances now seem to be based on complaint history and a local sense of how much can reasonably be allocated given the average land parcel size. There is a need to quantify the benefits of distance separation and thus to legitimize siting regulations.

Finally, it occurred to me during this Workshop that animal agriculture will increasingly find that manure is indeed not a nuisance byproduct but rather a valuable resource. If and when the phosphate reserves in the United States are depleted, will we be ready with processes to preserve the phosphorous content of manure and to extract phosphorous for sale off the farm? High value components are being found and successfully extracted from a wide variety of plant materials and it is not too great a stretch of the imagination to think that something similar could happen with manure.
CLOSING REMARKS

Jim Dalrymple
Ontario Ministry of Agric. Food and Rural Affairs
Brighton, ON.

Swine Specialist
Chair, Canada Comm. on Animals, Canadian Agri-Food Research Council

The past two-day symposium has attempted to bring together diverse groups to look at the issues related to animal agriculture and the environment. We would appreciate feedback, both good and bad, related to the discussions held at this symposium. We recognize that we have not dealt with all commodities such as the aquaculture industry which is on the increase in several locations in Canada.

This program has given the various groups the opportunity to increase harmonization across Canada. We have heard of excellent programs available in British Columbia where "peer review" is being well received. It appears that this process in British Columbia is similar to the process in Ontario by the Ontario Farm Animal Council with regards to animal welfare issues.

It is evident that the issue of animal agriculture and the environment is not unique to Canada and is being dealt with throughout the world. It is important that we address this issue from the area of research priorities and technology transfer needs as it relates to the North American Free Trade Agreement and GATT.

This symposium has attempted to assess and set priorities for both research and technology needs. The proceedings from this conference will be sent to all members of the Canadian Agri-Food Research Council which includes the Canadian Federation of Agriculture, National Farmers' Union, Consumers Association of Canada, Canadian Federation of Universities, Agriculture and Agri-Food Canada, National Research Council and other key players in research and technology.

Opportunities exist through Biotechnology, on-farm manure storage and management, and land application of manure to reduce criticisms currently existing with large-scale livestock operations and to improve the public's perception of animal agriculture.

This symposium has been an excellent beginning to address this critical issue. It is very important that the proceedings, discussion summaries, and list of those in attendance go out to not only the hundred people in attendance at this program, but to all interested groups. The goal of the Organizing Committee is to have Proceedings available and out to all participants as soon as possible.

The Organizing Committee, again, wishes to thank all the sponsors, the speakers, the facilitators, and, most of all, the participants of this symposium.

A special thank you to Dr. Jim Munroe, Agriculture and Agri-Food Canada, for Chairing the Organizing Committee and to him and his staff at the Centre for Food and Animal Research for all the local arrangements for this program.
LIST OF ATTENDEES

D. Allen
Nova Scotia Agricultural College P.O. Box 550
Truro, Nova Scotia
B2N 5E3
Tel: 902-893-6715
Fax: 902-893-1859

E. Asnong
Fédération des producteurs de porcs du Québec
555 boul Roland-Therrien
Longueuil, Québec
J4H 3Y9
Tel: 514-679-0530
Fax: 514-679-0102

M. Aumais
Ferme St-Zotique
200 69e Ave. St-Zotique, Quebec
JOP 1 ZO
Tel: 514-267-9732
Fax: 514-267-0636

S. Baidoo
University of Manitoba
Faculty Agriculture and Food Science
Winnipeg, Manitoba
R3T 2N2
Tel: 204-474-7323
Fax: 204-275-0402

E. Barber
University of Saskatchewan
Saskatoon, Saskatchewan
S7N 0W0
Tel: 306-966-5305
Fax: 306-966-5334

S. Barrington
McGill University
611 Lakeshore Blvd.
Ste. Anne de Bellevue, Québec
H9X 3V9
Tel: 514-398-7776
Fax: 514-398-8387

E. Beauchamp
Land Resource Science
University of Guelph
Guelph, Ontario
N1G 2W1
Tel: 519-824-4120
Fax: 519-824-5730

R. Bouchard
Dairy Farmers of Canada
75 Albert St.
Suite 1101 Ottawa, Ontario K1 P 5E7
Tel: 613-236-9997
Fax: 613-236-0905

C. Brown
Ontario Ministry of Agriculture, Food and Rural Affairs
P.O. Box 666
Woodstock, Ontario
N4S 7Z5
Tel: 519-537-6621
Fax: 519-539-5351

R. Bulley
University of Manitoba Agricultural Engineering
438 Engineering Bldg.
Winnipeg, Manitoba
R3T 5V6
Tel: 204-474-9868
Fax: 204-275-0233
W. Caldwell
Huron City Planning and Development Goderich,
Ontario
N7A 1 M2
Tel: 519-524-2188
Fax: 519-524-5677

A. Chambers
Canadian Chicken Marketing Agency 300-377
Dalhousie St.
Ottawa, Ontario
K1N 9N8
Tel: 613-241-2800
Fax: 613-241-5999

Y. Choinière
Ontario Ministry of Agriculture, Food and Rural
Affairs
Alfred College
Alfred, Ontario K0B 1A0
Tel: 613-679-2416
Fax: 613-679-2420

S. Clarke
Ontario Ministry of Agriculture, Food, and Rural
Affairs
Box 2004
Kemptville, Ontario
K0G 1J0
Tel: 613-258-8305
Fax: 613-258-8392

J. Crowley
Ontario Pork Producers' Marketing Board
15 Waulron
Etobicoke, Ontario
Tel: 416-621-1874
Fax: 416-621-6869

J. Dalrymple
Ontario Ministry of Agriculture, Food and
Rural Affairs
96 Dundas St.
Brighton, Ontario K0K 1H0
Tel: 613-475-1630
Fax: 613-475-3845

M. Dillon
N.B. Agriculture
P.O. Box 6000
Fredericton, N.B. E3B 5H1
Tel: 506-453-3488
Fax: 506-457-7267

P. Doris
Ontario Cattlemen's Association 130
Malcolm Rd.
Guelph, Ontario N1K 131
Tel: 519-824-0334
Fax: 519-824-9101

G. Duvel
University of Pretoria
South African Institute for Agriculture
Pretoria
S. Africa 0002
Tel: 012-420-3246
Fax: 012-342-2713

I. Edeogu
University of Ottawa
c/o John Feddes
4-10 AG/For BI
Edmonton, Alberta T6G 2P5
Tel: 403-329-1212
Fax: 403-328-5562
S. Godbout  
Université Laval  
Département de Genie Rural Québec, Québec  
G1K 7P4  
Tel: 418-656-3598  
Fax: 418-656-3533

L. Goonewardene  
Alberta Agriculture, Food, and Rural Development  
204-7000-113 St.  
Edmonton, Alberta T6H 5T6  
Tel: 403-427-5083 Fax: 403-427-1057

P. Grieger  
DGH Engineering Ltd.  
815 Blackdale Road Winnipeg, Manitoba R4A 9A4  
Tel: 204-334-8846  
Fax: 204-334-6965

D. Hanly  
Planning Department Perth County Court House 1  
Huron St.  
Stratford, Ontario N5A 5S4  
Tel: 519-273-3511  
Fax: 519-273-5967

E. Haupstein  
Dairy Farmers of Canada  
75 Albert St.  
Suite 1101  
Ottawa, Ontario K1 P 5E7  
Tel: 613-236-9997  
Fax: 613-236-0905

L. Helland  
Helland Land and Cattle Co.  
Box 7  
Lomond, Alberta T0L 1G0  
Tel: 403-792-2150  
Fax: 403-792-2339

T. Huffman  
68 Grange Ave.  
Ottawa, Ontario K1Y 0N9  
Tel: 613-759-1536  
Fax: 613-996-0646

H. Huffman  
Ontario Ministry of Agriculture, Food and Rural Affairs  
100 Enterprise Dr. Unit 7  
Komoka, Ontario  
N0L 1R0  
Tel: 519-473-6480  
Fax: 519-473-6431

C. Hunter  
Burnbrae Farms  
R.R.#1  
Lyn, Ontario K0E 1M0  
Tel: 613-345-5651  
Fax: 613-345-6946

T. Hursin  
Alberta Agriculture  
Edmonton, Alberta  
Ottawa, Ontario  
Tel: 513-489-1268

C. Iberg  
Idelle Farm  
23071-56 Ave R. R. #3  
Langley, British Columbia V3A 7N6  
Tel/Fax: 604-534-4686
L. Laflamme  
Research Coordination  
Agriculture and Agri-Food Canada  
Room 775, Sir John Carling Bldg. Ottawa,  
Ontario  
K1A 0C6  
Tel: 613-759-7853

G. Larson  
Quadra Management Services  
Box 638  
Outlook, Saskatchewan S0L 2N0  
Tel: 306-243-2022  
Fax: 306-243-2151

R. Leibel  
Saskatchewan Municipal Gov't  
1855 Victoria Ave.  
Regina, Saskatchewan S4P 3V7  
Tel: 306-787-2893  
Fax: 306-787-8748

S.-P. Lemay  
774 Myrand, 7  
Ste-Foy, Québec G1V 2V2  
Tel: 418-656-3598  
Fax: 418-656-3533

J. Leonard  
Department of Agriculture, Food and Nutritional  
Science  
University of Alberta  
Edmonton, Alberta T6G 2H1  
Tel: 403-492-0107  
Fax: 403-492-9130

M. Levesque  
N.B. Agriculture  
P.O. Box 5001  
Moncton, New Brunswick EIC 8R3  
Tel: 506-856-2277  
Fax: 506-856-2669

G. Linkletter  
P.E.I. Department of Agriculture, Fisheries &  
Forestry  
P.O. Box 1600  
Charlottetown, Prince Edward Island C1A 7N3  
Tel: 902-368-5643  
Fax: 902-368-5661

A. Manale  
Environmental Protection Agency  
Washington, DC  
USA  
Tel: 202-260-2753  
Fax: 202-260-2300

A. Marquis  
Université Laval  
Faculté des sciences de l'agriculture et  
development  
Québec, Québec G1K 7P4  
Tel: 418-656-3496 Fax: 418-656-7806

D. Masse  
Centre for Food and Animal Research  
Agriculture and Agri-Food Canada  
Building 94  
Ottawa, Ontario K1A 0C6  
Tel: 613-759-1583  
Fax: 613-759-1596

C. Maule  
University of Saskatchewan  
Department of Agriculture & Bioresources  
Saskatoon, Saskatchewan  
S7N 0W0  
Tel: 306-966-5306  
Fax: 306-966-5334
K. McKnight  
Saskatchewan Agriculture and Food  
3735 Thatcher Ave.  
Saskatoon, Saskatchewan S7K 2H6  
Tel: 306-933-5322  
Fax: 306-933-7352  

J. Morris  
Ridgetown College of Agricultural Technology  
Main St. E.  
Ridgetown, Ontario N0 2C0  
Tel: 519-674-1545  
Fax: 519-674-1555  

D.F. Morrison  
University of Guelph  
Department of Animal & Poultry Science  
Guelph, Ontario  
N1G 2W1  
Tel: 519-824-4120  
Fax: 519-767-0573  

J. Munroe  
Centre for Food and Animal Research Agriculture  
and Agri-Food Canada  
Bldg. 94, Ottawa, Ontario K1 A 06  
Tel: 613-759-1585  
Fax: 613-759-1596  

B. Murphy  
Agriculture and Agri-Food Canada  
Sir John Carling Bldg.  
930 Carling Ave., Room 479  
Ottawa, Ontario  
K1A 05  
Tel: 613-759-7202  
Fax: 613-759-7490  

W. Newman  
Ontario Pork Producers' Marketing Board  
15 Waulron  
Etobicoke, Ontario  
Tel: 416-621-1874  
Fax: 416-621-6869  

C. Nymark  
Environment Bureau Policy Branch  
Agriculture and Agri-Food Canada  
Ottawa, Ontario  
K1A 06  
Tel: 613-995-5880  
Fax: 613-943-1612  

J.F. Patience  
Prairie Swine Centre Inc.  
P.O. Box 21057, 2105 8th St. E.  
Saskatoon, Saskatchewan S7H 5N9  
Tel: 306-477-7450  
Fax: 306-955-2510  

N. Patni  
Centre for Food and Animal Research  
Agriculture and Agri-Food Canada Building 20  
Ottawa, Ontario K1A 06  
Tel: 613-759-1745  
Fax: 613-759-1765  

M. Patoine  
Ministere de l'environnement et de la faune  
Service de l'assainissement agricole  
et des activities de compostage  
2360 chemin Sainte-Foy,  
2 etage, boite 26  
Sainte-Foy PQ G1V 4H2  
Tel: 418-644-3589  
Fax: 418-528-1035
G.C. Smith
Nova Scotia Department of Agriculture and Marketing
P.O. Box 550
Truro, Nova Scotia B2N 5E3
Tel: 902-893-6531
Fax: 902-893-0244

V. Stevens
Centre for Food and Animal Research Agriculture and Agri-Food Canada
Building 55
Ottawa, Ontario K1A 0C6
Tel: 613-759-1457
Fax: 613-759-1465

G. Surgeoner
Environmental Biology
University of Guelph
Guelph, Ontario
N1G 2W1
Tel: 519-824-4120 (x3966)
Fax: 519-837-0442

D. Taylor
Ontario Ministry of Agriculture, Food and Rural Affairs
P.O. Box 1030
Guelph, Ontario N1H 6N1
Tel: 519-837-3112
Fax: 519-837-3049

M. Toombs
Ontario Ministry of Agriculture, Food and Rural Affairs
1110 Stellar Dr.
Newmarket, Ontario L3Y 7B7
Tel: 905-895-4519
Fax: 905-895-6739

D. Toombs
Ontario Ministry of Agriculture, Food and Rural Affairs
322 Kent St. W
Lindsay, Ontario K9U 5Z8
Tel: 705-324-6125
Fax: 705-324-1638

L. Townley-Smith
PFRA Saskatchewan
Agriculture and Agri-Food Canada
1800 Hamilton Street
Room 603, CIBC Tower
Regina, Saskatchewan S4P 4L2
Tel: 306-780-8095
Fax: 306-780-8229

B. Vaags
Manitoba Pork Est. 750 Marion Street
Winnipeg, Manitoba R2J OK4
Tel: 204-853-7948
Fax: 204-853-7924

J. Van Vulpen
Canadian Pork Council Suite 1101,
75 Albert St. Ottawa, Ontario
K1 P 5E7
Tel: 613-236-9239
Fax: 613-236-6658

J. Van De Walk
Ecologistics Limited
490 Dutton Drive Suite A1
Waterloo Ontario N2L 8H7
Tel: 519-886-0520
Fax: 519-888-7864
C. Weil
Ontario Ministry of Agriculture, Food, &
Rural Affairs
Alfred College
C.P. 580, 31 Rue St-Paul
Alfred, Ontario
KOB 1A0
Tel: 613-679-2417
Fax: 613-679-2420