CHAPTER 6

ENVIRONMENTAL AND HEALTH CONCERNS

Many concerns were raised about environmental and health issues during the Panel's public consultations, as well as in subsequent discussions. For purposes of analysis, these have been grouped under four main categories: water quality, air quality, health issues, and climate change and livestock.

Water Quality

Fears were often mentioned in presentations at the public hearings of deteriorating surface water and groundwater quality due to established and potential ILOs. Concern focused chiefly on large hog operations, and included both potentially leaking manure storages, be they constructed of steel, concrete, or earth, and on contamination of both surface water and groundwater due to manure application to land. Fears of water contamination in areas with a preponderance of porous, sandy soil were often mentioned. The regulation of manure spreading according to nitrogen content rather than phosphorus content, which can lead to an over-application of phosphorus and the potential for eutrophication, was also frequently mentioned, as was contamination of fields with the parasites and pathogens contained in the manure.

Also mentioned, but less frequently, were the possibilities of water contamination due to cattle feedlots, and of water contamination and riparian habitat destruction due to extensive cattle grazing. Several presenters pointed out that there was also the potential for water quality effects of other agricultural practices, particularly commercial fertilizer application, and stressed that livestock effects must be evaluated in the context of all activities in a watershed, including domestic sewage effects.

As mentioned earlier, a research round table on water quality was convened to assess the state of scientific knowledge on the relationship between livestock operations and water quality, current water quality monitoring programs, and the status and trends in the health of Manitoba's ground water and surface waters according to these programs. Based on what was learned during this exercise, as well as from other information sources the Panel makes the following observations and conclusions.

Generally speaking, the negative effect of specific large livestock operations on water quality has not been scientifically demonstrated. However, cumulative effects, likely from various sources including other agricultural activities, are producing deteriorating water quality in, for example, the Assiniboine River and Lake Winnipeg. The situation regarding recent eutrophication of Lake Winnipeg is particularly urgent. Research also indicates a reduction of biodiversity at several sites in Manitoba due to livestock operations (Pip 2000).

Unfortunately, inadequate monitoring of current livestock operations, and cutbacks in the 1980's and 1990's to both federal and provincial government water quality monitoring programs have left us in the situation of not being able to adequately assess the water quality effects of large livestock operations. The current level of monitoring and the system for coordinating and reporting monitoring results are insufficient to give the public confidence that the current intensification of agriculture is environmentally benign.

Procedures and guidelines for the location of large livestock operations, particularly with respect to manure storage and application, are much improved over the pre-1998 situation. Effects on water quality of pre-1998 manure storages that are not regularly inspected and maintained are of public concern, as are operations with less than 400 AUs. These smaller units are not prevented from spreading manure in winter which results in the greater likelihood of nutrient escape into water sources during spring run-off.

Concern About Phosphorus

In pre-agricultural times, the quality of Manitoba's waters was undoubtedly better than it is today. In those times, phosphorus, which is bound to soil particles, was discharged into streams, rivers and lakes in run-off at relatively low concentrations compared with today. As soils were developed for agriculture by clearing forest and breaking prairie, soil erosion increased, and with it, the amount of phosphorus delivered from soil to water also increased. Initial crop yields on these newly developed soils were high, but quickly declined as crop nutrients, chiefly nitrogen and phosphorus, were used up. Nitrogen and phosphorus, in the form of commercial or inorganic fertilizer, began to be added in ever-increasing amounts to the soil to restore crop yields.

Phosphorus is acknowledged to be the critical nutrient influencing the primary productivity and development of algal blooms in freshwater ecosystems. The addition of large quantities of additional phosphorus from external sources to Manitoba's soils likely increased phosphorus levels in our waters. However, most of this externally added phosphorus was shipped out of province in the form of grain.

The development of intensive livestock production in Manitoba has changed the dynamics of phosphorus movement. Grain containing the phosphorus that was previously exported to Europe or Asia is now being fed to livestock here at home. As manure from this livestock is applied to cropland, the phosphorus that previously would have been lost to the production system through export is now being recycled. One possible effect of this recycling is an increased phosphorus escape from soil to water and an accompanying increase in algal blooms, causing a decline in water quality. One manifestation of this effect may be the current situation in Lake Winnipeg, where large algal blooms have begun appearing in the north basin whereas in the past they appeared only in the south basin. However, the relative importance of manure, inorganic phosphorus and municipal sewage to water quality in Lake Winnipeg is not well understood.

Direct Run-off

Two particular characteristics of western Canadian settlement are known to have serious, detrimental effects on water quality.

People settled and developed farmsteads along watercourses, in order, among other considerations, to provide a source of water for their livestock. As a consequence, large numbers of cattle feedlots and wintering areas contribute run-off water to streams, and undoubtedly are having impacts on the Assiniboine River and Lake Winnipeg. Several government and non-government agencies are offering programs to encourage setbacks of livestock operations from water bodies. The federal Department of Fisheries and Oceans is in the process of taking steps to protect fish habitat. In addition, some producers are individually taking appropriate remedial measures.

Secondly, there have been a very large number of wells constructed throughout rural Manitoba since the mid-1800s to provide domestic and stock water. Many of these wells are deteriorating through disintegration of the casing, and provide a direct link between the ground's surface, where animals live, and the aquifers below that continue to provide domestic water. Aquifer contamination through such wells is thought to be responsible for a number of deaths near Walkerton, Ontario last summer. But perhaps even more serious is the large number of abandoned rural wells, many whose locations are no longer known. The potential for aquifer contamination from such a source is large. Several Conservation Districts offer programs to fill and seal abandoned wells, but doing the job properly requires resources in excess of those currently available.

Studies to assess the environmental impact of a range of human and agricultural activities, including domestic sewage, irrigation, and grain, vegetable, and livestock production, are currently not being carried out on an adequate spatial or time basis. Such studies, which must include measurements of the presence of nutrients (nitrogen and phosphorus), pathogens, parasites, and soil particles in surface and ground waters, are

essential to an evaluation of the impact of intensive livestock production on water quality. The impact of agriculture in general, and ILOs in particular, on water quality must be evaluated within the context of other human impacts on the landscape.

Recommendations Regarding Water Quality

Based on these observations and conclusions, the Panel makes a number of **recommendations** relating to water quality:

- **Water quality monitoring must be greatly increased to provide an assessment of the impact of livestock production on soil and water. A critical constraint to achieving this is the inadequate level of staffing for monitoring.** A monitoring system with sufficient detail to provide a water quality impact record of individual barns and groups of barns is required to give Manitobans a measure of the impact of ILOs on water. In addition, long-term monitoring of nutrient presence in ground water and surface waters from the range of agricultural operations, measured against a baseline of natural levels, is essential. The Deerwood Project, near Miami in south-central Manitoba, is a start in this direction, but more effort is needed.

- **Additional enforcement effort is required to ensure compliance with current regulations, particularly concerning manure management and storage, and penalties for infractions need to be increased.**

- **The province should move toward regulating manure application according to phosphorus content of soil and manure, and future ILOs should be located in order to provide sufficient acres for manure application according to phosphorus content.**

- **The province should continue to implement the recommendations of the recently released Drinking Water Advisory Committee Report, especially recommendations for a drinking water coordinating center that is properly staffed and supported.**

Air Quality

Probably the most emotional reaction to hogs is related to issues of air quality, often in the context that "pigs stink". The concerns raised at the public meetings ranged from odors impacting the quality of life of neighbors, to health hazards for barn workers, to disease transmission from animals to humans. The challenge facing the Panel was to separate largely emotional reactions to the nuisance of odors from genuine health hazards. We attempted to "get a handle" on the science, but found it an extremely complex area with woefully inadequate research. What follows is a brief commentary on the issue of odors from livestock operations. Health issues are covered in a following section.

Odors are among the hardest contaminants to manage because of the inherent subjectivity associated with measuring and defining what constitutes unacceptable levels. The reaction to odor in hog barns visited by the Panel ranged widely. People who are worried about odor from livestock operations probably will never accept assurances from government or industry that odors are not a problem unless it is possible to actually measure intensity at a site rapidly, with results that can be reproduced. Public tolerance is modified by the duration of an event and how often it is repeated. Different kinds of odor from swine, poultry or cattle, for example, produce different psychological and physiological reactions. All these factors challenge research and the development of practical measurement devices while the industry addresses the task of reducing the strength of odors and arranges its infrastructure so that the worst can be avoided. It is also important to note that the reduction of odors often runs in parallel with the protection of health. A clean and well-ventilated barn means fewer pathogens for potential transfer to workers as well as a less offensive aroma.

Some presenters at the hearings, deeply concerned about odor which affects their enjoyment of rural life, found it anomalous that a municipal council would first zone and subdivide to attract their residency then allow an ILO to locate near enough to cause a nuisance.

Others advocated special areas within agricultural zones for these operations, where they were least likely to create disappointed neighbors. It was often said that Manitoba municipalities have plenty of space in which to maneuver. The Panel itself continues to wonder why the setbacks suggested in the Farm Practices Guidelines are seldom exceeded.

Notwithstanding our sympathy for the "right-to-farm" advocates and bearing in mind that new ILOs will be more effective in odor control than those of the past, we believe that initial siting decisions should receive very careful analysis of potential air quality issues that can be assembled by the municipality before each decision is rendered. This should take into account how the operator intends to cover the storage and how and when the manure will be spread. Local climate and landscape might be as important in odor distribution as distance to neighbors in some parts of the province. Considerations of cumulative impacts should include the effects of on-site expansion in the future as well as the general regional air quality to which clusters of ILOs contribute.

Odors originate from barns, manure storage and manure spreading. Minimizing their impacts is very much a management consideration, management that includes a commitment to maintaining the best possible relationships with neighbors. Operations should be sufficiently flexible to allow for spreading, for example, to accommodate both the neighbors' life-style and the weather.

Looking to the immediate future, covering manure storage either with straw or fabric, using feed additives to reduce odor production in the animal, and swift incorporation of manure into the soil promise better air quality at least expense for improvement in practices. There remains the fact that aerobic treatments such as aeration and composting, though more effective in odor control as compared with slurry systems, are less convenient and more costly.

Similarly, effective measures to reduce nitrogen loss by covering manure storage or direct injection of manure into the soil are also accompanied by odor reduction. Current research into the quality of the nutrient and its mode of distribution is also likely to lead to some odor reduction.

The idea that manure is a waste rather than a resource continues to linger in our psyche. We speculate that this attitude is not yet wholly purged from the industry, let alone from the general public. Scientific testing of stored manure to match its nutrient availability with that of the soil and the needs of the crop, rather than estimating each of these factors, is clearly warranted. A potential double benefit exists here. Perhaps this is indicative of the need for stricter standards for the removal of manure from storage and spreading it on to or into the fields.

Our view is that the utmost care in managing the sources of odor will always be required. While improvements in reduction of odors based on a steady research effort can be expected, we are less optimistic that odor complaints will decrease.

Suggestions and recommendations pertinent to air quality follow "Health Issues" below.

Threshold Level for Regulation of ILOs

Concerns regarding water and air quality impacts of ILOs have raised the question of the appropriate level for regulating the size of ILOs. Current regulation requires an annual manure management plan to be filed with Manitoba Conservation for an operation with 400 AUs or more. Though the practice is discouraged, operators with less than 400 AUs are permitted to spread manure in winter. A lower threshold level was advocated by many presenters at the hearings. The Panel was also told that it should be cumulative across species, that is, the regulations should kick in when the animal units in hogs plus those in other livestock exceed 400. The cut-off in other provinces is generally 300 AUs. Under The Clean Water Act in the U. S., a "point source" includes a concentrated animal feeding operation and regulatory control begins at 300 AUs. In Europe, the mode is to control on the basis of the number of animal units per hectare of land used by an operation.

The main argument from moving from 400 AUs to a lower threshold in Manitoba, however, is that this is a step in controlling nutrient escape. The Panel believes that lowering this number should facilitate planning and increase the general knowledge of the livestock industry in terms of both location and stewardship. The Panel did not have the opportunity to explore the question in depth, but it believes the question warrants careful study in the Manitoba situation, taking into account the density of operations upon the landscape.

Recommendation:

- **The calculation of animal units should be cumulative across species.**
- **In view of the lower threshold level in other provinces and some municipalities in Manitoba, the Livestock Manure and Mortalities Regulation should be modified to require manure management plans for all new and existing ILOs of 300 AUs or more, and that winter spreading of manure be prohibited for all new and existing ILOs above 300 AUs.**
- **This reduction should be phased in over a reasonable period and should be coupled with an expanded monitoring effort, expert advice and, possibly, incentives to encourage revamped manure management structures.**

Health Issues

The public perception of health issues associated with the intensive livestock industry is influenced by four circumstances.

First, there is a lack of confidence that government is "on the ball". Expansion of livestock numbers, especially hogs, is not perceived to be accompanied by adequate monitoring and enforcement that anticipates problems and responds quickly to them. Although there is enough evidence to suggest that bacterial contamination of water supplies, for example, has been around for a long time, the logic is that when manure is produced in large volumes, the risks are increased. Efforts by the industry to point to the care with which pigs are raised - the market is a potent force to encourage disease-free production - are likely to be met with skepticism.

The second and very current circumstance is directly connected with the Walkerton findings and the Manitoba Drinking Water Advisory Committee Report. Notwithstanding the valuable lessons and good intentions that follow such investigations, e.g., regular testing of water, the public asks why government has to catch up with the data and what is to be done about prevention of water pollution.

The third circumstance is that odor and personal health are intimately connected in peoples' minds. The view is that if it stinks, it can't be healthy - even allowing for a higher tolerance on the part of farmers for odor! Some presenters at the hearings felt that if odor were better controlled, the complaints about the expansion in hogs would diminish.

The last circumstance is that the media makes the most of every potential threat to public health, putting insufficient energy into collecting the range of scientific opinion that directly relates to issues about the Manitoba environment.

If the risks to health are contained, and are seen to be contained, by the actions of an alert government, will there be less opposition to intensive livestock operations in Manitoba? The question cannot be answered in this report. We do know, however, that the industry has to establish its reputation for meticulously attending to health issues.

The discussion that follows is intended to highlight some conclusions that seem important from a wide documentation and discussion of health impacts related to livestock operations. It is not an overview in the sense of some documents we have received (Mussell and Martin 2000, Pip 2000), but it has given the Panel the basis for a number of recommendations.

Waterborne Transmission of Pathogens

The following quotation seems to capture the waterborne transmission process from livestock to humans in a way that stimulates thinking on practical, defensive measures that operators can take.

> *Four primary steps need to occur for waterborne transmission of pathogens from livestock to humans. Eliminate any of these steps and transmission of the specific pathogen from livestock to humans through water can significantly be reduced or even stopped completely. First, the pathogen must be excreted by livestock. Second, the pathogen must reach a water supply either by the animal defecating in the water, by overland flow (runoff from a grazed pasture during rainfall, snowmelt etc.), by subsurface flow, or by combination of these three pathways. Third, the pathogen must retain the cellular functions necessary for initiating a new infection in humans during the time it is in the environment. Lastly, given that the pathogen is shed by livestock, reaches a water source, and remains infective until ingested by a human, the concentration of infective pathogens must be sufficiently high in order to initiate an infection. (Atwill 1997)*

Such interventions engage the attention of a good operator every day. In a hog barn, for example, he can start with pathogen-free stock, raise pigs in age groups, sanitize between batches, and be strict about bio-security. He is regulated on manure handling and livestock mortalities under provincial law, and subject to inspection of what is regulated. He can organize the specializations of his workforce around the intervention points. There is a continuous flow of updated information from trade and research organizations. The market imposes strong discipline, especially on product quality. As for all types of farming, there is an opportunity for the public to prompt investigation of inappropriate behavior under T*he Farm Practices Protection Act.* At the hearings, we heard opinions that the in-barn operations of ILOs are usually well conducted. Despite these assurances, however, we wonder whether sufficient inspection is maintained to confirm this view. The public makes judgments based on its sense of smell and contact with barn workers. It knows very little of the procedures in the barn. Lack of knowledge intensifies fear.

It is the situation outside the barn to which most regulatory attention has been addressed, seemingly for two strong reasons - the usefulness of the nutrients in the manure, and their potential for overloading ground water and surface waters if not handled carefully.

Traditionally it was thought that a lot of pathogens would die once they left an operation and the manure was incorporated into the soil. Naturally occurring soil bacteria do attack manure pathogens with vigor, but some survive in the manure and eventually reach humans. One intervention is to hold manure in storage until the pathogens die. Unfortunately for the operator, that time varies substantially. For example, E.coli 0157-H7 is said to survive more than 100 days in bovine manure at -20C, Salmonella 35 days in a manure pit at 22C to 27C. Animal faeces containing Giardia cysts and Cryptosporidium oocysts should be distributed on fields during warmer weather and after 12 weeks of storage to reduce potential water contamination following heavy run-offs, (Olson, 1999). There is undoubtedly a "best practice" for intensive livestock operations in Manitoba. Finding it should be a research priority.

Towards Healthier Breathing

In-Barn Air Quality

Ambient levels of gases and dusts inside confinement hog facilities can be a health hazard to workers as they can potentially contain harmful levels of ammonia, hydrogen sulphide, methane, endotoxins, carbon monoxide and carbon dioxide. In addition, the air may include dust particles made up of feed components, dried faecal material, hog dander, moles, pollen, grains, insect parts and mineral ash. With the increased use of confinement operations and the need for full-time staff, air quality has become an important issue related to worker health. A substantial reduction of the dusty and odorous work environment

would ensure improved worker health and assist the industry in attracting capable and qualified staff.

Because of the combinations of various gases and dusts present in the barn, the air may have a more negative impact on health than any one type of agent or gas. The severity of an individual's symptoms depends on the duration and time spent in the barn, the concentration of contaminants, the usage of personal protection equipment and the individual's susceptibility. Sensitivity also varies from person to person, depending on their general state of health. However, the most common health problems are dust-related: coughing, phlegm build-up and scratchy throat.

Chest tightness, coughing, nasal and eye symptoms can occur within 30 minutes of entering a barn but usually require two or more hours of exposure. This bronchitis results in excessive coughing and phlegm production and is usually worse in winter when ventilation rates are lower to conserve heat. Workers may experience delayed reactions up to six hours after working in confinement barns. Organic dust toxic syndrome (ODTS) often occurs after moving or sorting pigs, or cleaning the building or grain bins. Its symptoms can include fever, malaise, muscle aches and pains, headache, cough and tightness of chest. Full recovery may take three or more days. It is often mistaken for the flu.

Long-term exposure can result in chronic bronchitis, decreased respiratory capacity, occupational asthma related to allergens and dust, and increased sensitization to allergies. A recent study has shown that odors also can cause negative moods that can depress the body's immune response and influence physical health.

Of equal concern is the exposure to potential diseases and the use of animal antibiotics on human health. Manure can contain microorganisms that pose health risks to workers from infection and microbial toxins. Many infectious organisms that cause disease in animals can also cause illness in people. The potential exists for some of these microorganisms to be transmitted through the air. Use of anti-microbials to prevent the rapid spread of disease in confined barns may result in the evolution of resistant organisms. Clearly, research is needed to better understand the extent and severity of these potential health risks.

Management controls, personal respiratory protection and engineering interventions have an important role in reducing health risks due to in-barn air quality. Management controls, especially in barns with poor air quality, could include limiting the time a worker spends each day in the building. This would allow "recovery" time from the exposure. Personal respiratory protection would include the use of dust masks, full-face respirators or gas masks. Studies have shown that the reduction in the amount of dust inhaled is very substantial for a properly fitted mask. Chemical cartridge respirators also are effective for removing certain gases. For oxygen deficient areas such as manure pits, supplied air respirators are necessary. Although the issues of discomfort and difficulty communicating have hindered the use of masks, education efforts are encouraging younger workers to use respiratory protection.

Engineering controls include the use of agents to reduce dust and gases, installation of monitoring equipment to record toxic gas levels on a continuous basis and installation of adequate ventilation systems. Recent research has indicated that by adding two percent canola oil to the feed, the respirable dust concentrations are reduced 45 percent. Further, spraying a mixture of five percent oil and 95 percent water in swine buildings also can reduce dust mass by 60 to 90 percent. This spray mixture also reduces ammonia levels. Minimizing the distance feed drops from feeding systems and the diameter of the pipe it is dropped from help reduce dust levels. Air filtration and scrubbing and air ionization are also effective in dust control. However, nothing can surpass simple good management — keep the barn clean!

Farmers who employ workers have to follow the same occupational health and safety rules that apply to other industries. To date, monitoring of hog barn air quality by government departments has been minimal. Instead, the focus has been on

ensuring that the building design will reflect the latest technologies available to maximize air quality. It has been assumed that the operator will follow practices to ensure maintenance of good air quality.

Despite the philosophy of best intentions, agriculture workers are not covered by labor legislation in Manitoba. Many believe that minimum wage provisions and Workers Compensation should protect all workers in the livestock industry. Others feel that education and staff training programs are the best means to ensure compliance and ongoing due diligence.

Both the employer and the worker share the responsibility for a safe work environment. Employers must provide sufficient training and information, while workers must follow established safety and health policies and utilize equipment in a responsible manner. Because of this, there is an ongoing need to undertake research on exposure limits, the impact of exposure to multiple airborne hazards, the long-term effect of air quality and the impact of viral interactions on worker health, and to communicate this information in an effective manner to the farming and health communities.

Air Quality for Residents Near ILOs

Some view odor as a nuisance rather than a health issue. Others mistakenly assume that taking care of odor is synonymous with addressing the health problems of people who live near ILOs. For hog facilities specifically, the Panel heard some complaints that nearby residents experience symptoms of fainting, weakness, dizziness, nausea and respiratory problems that mimic those experienced by inside workers. The lesson from this for the Manitoba industry is, again, that very careful attention must be paid to the initial siting of an ILO, taking advantage of the space and terrain, and being cautious about clustering. A current study by DGH Engineering and Laval University which involves interviewing neighbors of a large number of hog barns regarding experience with odor, will provide important information on how much hog barns stink, on health concerns, and on the adequacy of municipal by-laws regarding separation distances to nearest neighbors.

Antibiotics

The Panel heard little about the use of antibiotics as a production tool in raising livestock. As long ago as 1972, the U.S. Food and Drug Administration proposed that all antibiotics used in human medicine be used in animals only for short-term therapeutic purposes prescribed by a veterinarian. A recent letter from 30 organizations and over 50 doctors to the Commission of USFDA (Lai 2000) urged the banning of subtherapeutic uses in livestock of any antibiotics used in (or related to those used in) human medicine. On November 10, 1999, a bill called The Preservation of Essential Antibiotics for Human Diseases Act of 1999 (Brown, Waxman, Slaughter) was introduced into the U.S. House of Representatives. It stated that seven antibiotics, including penicillin and tetracycline, already approved as livestock feed additives, must be banned if, within two years, the drug-maker does not submit data that such use is safe. As well, it should be noted that Canada and the U.S. are well behind Europe in introducing these protective measures.

In essence, the concern has become widespread that bacteria develop defense mechanisms against antibiotics and become resistant to drug effects. When such resistance develops, the bacteria are no longer killed, and the antibiotic is incapable of treating or curing the disease. Humans are sickened through exposure to infected animals and from tainted meat bearing the resistant bacteria. They are not readily cured from treatments commonly prescribed.

The Panel was confronted by one opinion that intensive livestock operations are not feasible without subtherapeutic drugs in the food supply, and another opinion that, in Manitoba, we are not using antibiotics to a significant extent. The Panel's view is that practices in Manitoba, such as adding antibiotics to feed, require careful examination by industry, the medical profession and Manitoba Health. The Panel has the impression that, if there is a stance or policy on this matter, it is not in the public domain.

Disposal of Livestock Mortalities

The disposal of livestock mortalities is not addressed in this report, as there were few references to it at the public meetings. However, the Panel suggests that government review current practices, regulations, monitoring, and inspection to assess the capacity of this part of the industry to handle livestock expansion, and reassure Manitobans that health risks from this source are minimized.

Recommendations on Health Issues

The Panel believes that attention to improving water quality, as recommended earlier, and the improvement of management practices, can go far to further reducing the risks to health from ILOs.

Recommendations:

- **Strong research and development emphasis should be placed on the monitoring of pathogens and the mechanisms by which they are transferred from animals to humans, and upon factors such as the design of barns, manure storages, and spreading practices which minimize such transfer.**
- **Government, in conjunction with the industry, should review the in-barn environment with a view to:**
  - **establishing a monitoring regime and ensuring compliance with existing regulations, especially those affecting the health and safety of workers,**
  - **assessing the training needs of barn workers, and**
  - **identifying research priorities which bear upon the health of operators, workers and the nearby public.**
- **All barn workers should be strongly encouraged to wear proper masks.**
- **Greater attention should be paid by the industry and government to familiarizing the public with the in-barn environment and precautions that are taken to raise healthy animals.**
- **As a matter of responsibility to Manitobans, government and the industry should make clear why and how the industry uses antibiotics.**

Livestock and Climate Change

Climate change, caused largely by human activities, is acknowledged by the world's climate scientists to be occurring, and recent predictions of timing and intensity of severe weather events make the situation worse than previously believed. Agriculture, including livestock production, is a source of the greenhouse gas emissions that cause climate change (about 10 percent in Canada). Sources of concern regarding livestock include emissions of methane. Methane is emitted from manure storages and from both ends of ruminants. Emissions can be reduced significantly, for example, by covering manure storages and by injecting liquid manure below the soil surface. Covered storages and manure injection also reduce odors significantly and reduce nitrogen losses, thus preserving the nutrient content of the slurry.

Major predicted effects of climate change on agriculture include an increase in annual mean temperature, with the greatest increase coming in winter, an increase in the variability of weather, including heavy rainfall and floods, and a change in the precipitation regime. Precipitation predictions are less reliable than those for temperature, and currently indicate drier winters and summers, and wetter springs and autumns, although there is the possibility of increased drought, especially in southern areas.

Consequences of climate change to livestock production will largely relate to water shortages, even drought. Therefore, production systems with a minimum water requirement should be researched and developed. Increasing variability of weather means that floods will continue to occur, with perhaps increased frequency and intensity. The siting of livestock operations on flood plains or areas prone to flooding should require

additional precautions in manure storage design to guard against manure having an impact on the environment as a result of flooding.

Recommendation:

- **The Government of Manitoba should give serious consideration to accelerating the process of making the public generally, and the agriculture sector particularly, aware of the impacts of climate change, and the range of measures for mitigating and adapting to climate change.**