A FRAMEWORK
FOR
ANALYZING POLLUTION ABATEMENT CONTROLS
IN
MANITOBA

BY
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SUMMARY

"Environmental degradation" has many different meanings to different individuals. The concern for environmental degradation can mean anything from annoying odour to pollutants in water resulting in a health hazard to humans. The primary concern in this study is with degradation resulting in public policies and regulations. The particular policies and regulations of concern are those relating to livestock operations in Manitoba. A description of the licences issued to livestock operators by the Clean Environment Commission is given in Appendix A under "Soil Emissions". The regulations controlling livestock operations in Manitoba is given in Appendix B. The summary of licences and the regulations indicate the concern for environmental degradation that the Province of Manitoba has.

Recent concern about "environmental degradation" has led to the introduction of environmental controls across Canada. The controls can result in alteration in and among the various sectors of the economy. In order to understand the impact of these controls, an analysis of the alterations that occur could be undertaken. This involves an analysis on a sector basis and then inclusion of this analysis in a larger economy-wide framework. Thus the objectives of this study are:

1) To develop a framework to analyze the effects of pollution controls;

2) To measure the benefits of livestock pollution

abatement to an individual farm operator for an illustrative example;

3) To measure the costs of livestock pollution abatement to an individual farm operator for an illustrative example; and

4) Review the general job and income benefits of increasing livestock production in the Interlake area of Manitoba.

A six component framework outlines the context within which the single operation should be examined. The components of the framework include: 1) legislation; 2) enforcement; 3) area economic relationships; 4) individual benefits and costs; 5) social values; and 6) public goals affected by environmental legislation.

The single operation examined in this study serves as an illustrative example on the use of benefit-cost analysis to determine the impacts of pollution abatement. The analysis of the single operation revealed no benefits accruing to the operator associated with pollution abatement, and only minimal costs. The amortized cost of pollution abatement construction over a 20-year period plus the operating costs results in an annual cost to the operation of $1422. This is approximately 0.5% of the total revenues received by the livestock operation.

The impacts of pollution abatement on the entire livestock industry can only be determined by a complete analysis of all the livestock operations in Manitoba.

The actual effects of pollution abatment on expansion of the livestock industry cannot be determined from the single operation examined. The effects of pollution abatement expendi-

tures on the expansion of the single operation appear to be minimal. However, smaller operations may not be able to take advantage of economies of scale and a larger portion of the expansion dollars may be diverted to pollution abatement. This would result in less productivity associated with expansion than would occur without pollution controls.

CHAPTER I

INTRODUCTION AND PROBLEM STATEMENT

Introduction

"Environmental degradation" as a result of economic activity has resulted in a growing concern about the ability of the environment to assimilate residuals from production. This has led to the introduction of pollution controls in the provinces across Canada. These pollution controls result in alterations in and among the various sectors within the economy. In Manitoba these alterations are not entirely understood. There is a need to analyze what effect these controls have on the economy of Manitoba on a sector basis (agriculture, manufacturing, government) and to include the sector analysis within an economy-wide framework.

Problem Statement

Manitoba has enacted legislation, as have other provinces, to control pollution. Controls have a possible effect on economic activity by altering the operations of specific activities. These alterations create benefits and/or costs.

The Manitoba government has indicated as a policy its desire to expand livestock production to increase farm incomes.[1] Regulations have been designed and brought into

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[1]Province of Manitoba, Guidelines for the Seventies (3; Introduction and Economic Analysis; Manitoba: March, 1973), I,85-86.

effect in Manitoba to cope with environmental degradation resulting from livestock operations. Regulations result in alterations in the production process of individual sectors. In light of the indicated government policy, there is a need to develop a framework that includes all sectors of the economy. This allows individual sectors being examined, for example, livestock operations, to be placed in an overview perspective for examination of the effects of pollution abatement on the stated government goal of increasing farm incomes, as well as other public goals.

CHAPTER II
REVIEW OF RELATED STUDIES

Introduction

Each economic system, whether a country or a single province is a complicated interaction of activities. Every move to improve some sector results in changes in other sectors. Pollution controls are no different. Legislators introduce controls in order to prevent environmental degradation. However, in order to minimize the effects of residues, production of goods and services would be altered. The cost of production may be increased or operations may be forced to decrease or stop altogether.

In addition to the impact of controls on the business sector, there is also an impact on areas of the economy that are supported by public funds. In Manitoba, the Clean Environment Commission issues licences to such bodies as municipalities and school boards. Municipalities apply to operate waste disposal grounds and sewage lagoons or treatment plants. School boards apply to use incinerators. The Crown itself, is also bound by the Clean Environment Act. The Clean Environment Commission sets standards for these operations. Meeting the required standards may involve additional costs to these bodies.

To determine what impact these costs have, it must be determined who pays the final cost. Taxes are generally increased to meet the increasing costs. Municipalities generally use their own funds to pay for waste disposal grounds and sewage treatment. The funds come from the taxation of property

and business sales. Municipalities also finance schools, but a large portion comes from the provincial government. Provincial funds come mainly from income taxes. Study of the incidence of taxation is required in determining who pays the cost of pollution abatement.

The effect of environmental controls cannot be studied in isolation. Pervasive effects of pollution require a comprehensive analysis. The following section includes a review of literature that relates to this end. The models discussed are economy-wide models that include the environment as an integral part of the system.

Theoretical Concepts in an Economy-Wide Context

Recently the realization of a finite resource base and assimilative capacity of the environment has resulted in a growing body of literature concerning the economic-environment relationship.[1] Several models have been developed that relate economic and ecological processes. Victor, in his book, Pollution: Economy and the Environment, discusses models constructed by Cumberland, Daly, Isard, Leontief, Ayres, and Kneese.[2] Cumberland, Daly, Isard, and Leontief use input-output models that are adapted to incorporate environmental sectors. Ayres and Kneese take a different theoretical approach. A materials balance approach is taken, assuming that matter cannot

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[1] Peter A. Victor, Pollution: Economy and Environment, (Toronto and Buffalo: University of Toronto Press, 1972). The following discussion is based on Victor's summary of these models.

[2] Ibid.

be created or destroyed as materials are taken from the environment. The production functions of the market are included, but they do not consider the production functions that occur in the environment. A complete model would consider economic and environmental relationships.

Victor has several criticisms of the model that Ayres and Kneese have developed. One problem associated with their model is that it is static. Wastes introduced into the environment require a dynamic analysis. The assimilative capacity of the environment today is affected by the wasteload of yesterday. The environment does have the ability to cleanse itself but this can be exceeded. The most serious criticism of this model is it cannot be readily applied. It does, however, highlight the interactions between an economy and the environment.

Cumberland designed an input-output table that incorporates economic and environmental interactions. An extension input-output table includes environmental benefits, environmental costs and net differences between them. The costs of restoring the environment to predevelopment condition are considered but in none of these cases are calculation procedures specified.

Daly brings economic interrelations, environmental interrelations and relations between the economy and the environment into one comprehensive model. The world is divided into human and non-human sectors. Interactions within the human sector are those normally thought of as economic, those in the non-human sector are referred to as ecological.Goods that flow from the human to the non-human sector are externalities. Those

that flow the other way are 'free' goods. Daly's model shows the interdependencies between the human world exchange and production and the biological world.

Daly's input-output table is divided into four quadrants. In the quadrant that demonstrates the standard input-output model, the flows are measured in dollars. However, in the case of the ecological commodities, dollar measurement becomes difficult because these are not marketable. Therefore, using this table as an analytical model leads one to add incommensurables.

Isard's model is similar to Daly's. Isard, however, uses a different method of determining the coeffeicients of the input-output table. Isard calculates the coefficients directly and Daly used an accounting framework from which he could calculate the coefficients. Isard's model can be criticized for its assumptions of fixed coefficient production functions. However, Victor adds this criticism can be levelled against most purely economic input-output models.

The Leontief model is closer to Cumberland's model than the other models discussed above. Leontief concerns himself only with the flows from the economy to the environment and not the flows in the opposite direction. He uses pollution coefficients that relate the output of each waste to the activity of each industry. Leontief's model can be used to estimate price effects of changes in anti-pollution technology and for government policies that regulate industrial pollution. The most serious criticism that Victor has for Leontief's model is his lack of recognition of the materials balance approach which he feels "provides an accounting identity which bonds the

economy to the environment.[3]

The models in the above discussion require detailed information currently unavailable in Manitoba. Their information requirements are too numerous to pursue in a study of this depth. However, these models indicate the context within which pollution controls should be analyzed.

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[3] *Ibid.*

CHAPTER III

POLLUTANTS AND RELATED PROVINCIAL LEGISLATION

Physical Description of Pollutants

In order to understand the need for pollution controls, a brief description of what constitutes pollution follows. Emissions into the atmosphere are unique. These emissions are not subject to bacterial degradation as emissions into the water may be. There is some degradation of emissions by chemical and photochemical action. Air has great dispersing and mixing properties and from this arises its ability to assimilate waste materials. Temperature changes and wind movements can alter the assimilative capacity. An air inversion, such as those which occur over Los Angeles, could easily prevent mixing and cause a dangerous accumulation of air emissions.[1]

Although Manitoba has relatively clean air,[2] continued emissions of large volumes of waste into the atmosphere would

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[1]Wesley Marx, Man and His Environment: Waste (New York, New York: Harper and Row, Publishers, Inc., 1971), 20-28.

[2]Province of Manitoba, Annual Report of the Clean Environment Commission For the calender year ending December 31, 1971, 1972 and 1973.
From a wholistic viewpoint, Manitoba has clean air. However, local problems do exist. Winnipeg has a relatively high dust level. Also gaseous contaminants such as lead and sulphur dioxide are serious in industrial areas. In the St. Boniface area malodours from rendering and the blood drying operations of meat packing and rendering plants cause discomfort and are being closely examined by the Commission. Odours from livestock operations are a problem but are not considered in the regulations. Chemical pesticides and herbicides are being examined by the Commission as areas of great concern.

soon result in emissions exceeding the waste-receiving capacity. This type of accumulation can change the composition of air making the air toxic and corrosive.[3] In Flin Flon and vicinity this was happening until a high stack was installed by Hudson Bay Mining and Smelting to carry the contaminants to higher levels.[4]

The problems of air pollution within Winnipeg differ from the rest of the province. The main problems within Winnipeg are that of dustfall, odours, and gaseous emissions from industries. The problems outside the city of Winnipeg mainly include the odour from animal operations in the rural areas and odours and particulate emissions from mining and smelting in resource centres.[5]

Water is another medium which is often used for waste disposal. Water's ability to accept waste comes from the actions of dilution and bacterial decomposition. The movement of water allows it to replenish its supply of oxygen so that it may continue bacterial decomposition. However, continued use of waterways to ever greater extents for dumping disharge or contaminants may result in oxygen depletion of the waterway. The result is severely polluted waterways where life[6] is impossible. Other problems resulting from emissions come from an added nutrient

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[3]Marx, 21.

[4]Information from the staff of the Environmental Protection Branch, Department of Mines, Resources, and Environmental Management, Province of Manitoba.

[5]Province of Manitoba, Annual Report of the Clean Environment Commission, 1972.

[6]Life is usually defined as a specific type, for example, fish life.

load in water. Nutrients such as nitrogen, phosphorous, and carbon which originate from domestic and industrial effluent, and fertilizer runoff, result in increased algal growth. This may speed the eutrophication process in lakes.

Manitoba has relatively 'clean' waterways. The water emissions on the whole have not had a serious effect on water quality.[7] However, care must be taken to prevent overuse of the receiving capacities of waterways.

Soil as a waste receiver differs from water and air in that it does not disperse wastes. In addition, in some sanitary landfills, there is the problem of increased rodent populations and increasing numbers of flies and other insects.

Manitoba has a particular problem relating to waste disposal. Tracts of land must be rehabilitated after wastes have been buried. Problems related to groundwater also occur. Several municipalities have groundwater polluted by gasoline, suspected to have come from underground storage tanks. Such municipalities include Stonewall, Birdshill, and Flin Flon.[8]

The above is a general description of contaminants that enter the natural recipients air, land and water. These set the

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[7]Province of Manitoba, Annual Report of the Clean Environment Commission, 1972 and 1973.
Water quality is good from a wholistic viewpoint. However, local problems do occur. Raw sewage was being released into the Red River in south Winnipeg and Selkirk. This has been remedied by the installation of sewage treatment plants in both locations.

[8]Province of Manitoba, Annual Report of the Clean Environment Commission, 1973.

stage for the more specific discussions relating to livestock wastes, their compostion, and effects on the natural recipients.

From the operation of various types of livestock operations come an output of pollutants. The composition of pollutants are subject to many variables.[9] Each animal species produces different types and amounts of manure. Animals with simple stomachs, such as swine and poultry, produce small quantities of total excrement because of their highly concentrated and digestible diet. Ruminants (such as cattle and horses) consume large portions of roughage and as a result produce relatively large amounts of manure per unit of feed consumption. Bird excrements contain most of their nitrogen in the form of uric acid rather than urea. Fresh excrement has a higher solids content than non-avian residues.

The composition of manure is subject to other variables also. Management factors such as water consumption, environmental temperature and relative humidity, manure collection and storage methods also affect manure characteristics. D. Schulte sums it up by saying:[10]

> "...'manure' may mean:
> (1) liquid manure including both the urine and faeces and water from washing, spillage, etc.;
> (2) urine and faeces plus varying amounts of bedding;
> (3) solid material remaining after the liquid portion has evaporated or drained away;
> (4) the liquid portion of the total excrement; or
> (5) fresh excrement including only the urine and faeces.

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[9] Dennis Schulte, Rough draft of chapter 17 in Principles and Practices of Commercial Farming (Agricultural Economics, University of Manitoba, 1974).

[10] Ibid.

> The digestibility, protein, and fibre content and additives such as antibiotics, copper, arsenic, sand, or grit in feed rations are also important factors in the chemical, biological and physical properties of fresh manure from all species."

Because wastes can vary widely from operation to operation, many types of waste management techniques are used. Therefore, it is essential that regulations and other controls are not so specific as to eliminate effective methods of management that are specifically described in regulations and legislation. It is probably for this reason that many provinces and the federal government have introduced codes of practice and have not made them mandatory. By making them mandatory, new innovative techniques for waste management are difficult to introduce.

Environmental Controls in Manitoba

Until the Clean Environment Act was passed in 1968, Manitoba environmental controls were largely the responsibility of the Department of Health and Social Welfare. Few environmental problems could be dealt with unless they affected public health.

Under the Clean Environment Act, the Clean Environment Commission (CEC) was set up on June 15, 1968.[11] The CEC

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[11]Several amendments have been passed to the act since passage in 1968. Some of the major amendments include: (i) The CEC reported to the Minister of Health and Social Development until April 1, 1971 and after this date to the Minister of Mines, Resources and Environmental Management; and (ii) On November 1, 1972 the issuance of licences was replaced by orders.

objectives established in the act include air, soil and water quality control. Quality control is defined by the prescribed limits established by the CEC or regulations.

Under the Clean Environment Act, regulations can be implemented to control pollution. Regulations relating to livestock were passed February 13, 1973.[12] The passing of these regulations resulted in livestock operations being exempt from Commission prescribed limits on pollution. These regulations were the first regulations to come into effect under the Clean Environment Act.[13] This may be taken as an indication of the importance of livestock waste production in the province and a need for analysis of these controls.

These regulations have limits similar to those contained within the licences and orders issued by the Commission previous to the regulations coming into effect. The regulations pertaining to livestock are given in Appendix B.

The CEC issues orders limiting emissions by corporations or individuals. The CEC licences/orders and the livestock and other regulations serve as a link between economic activity and the environment. The licences/orders and the conditions within

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[12]Province of Manitoba, Being a Regulation Under the Clean Environment Act Respecting Livestock Production Operations (Manitoba Regulation 34/73, filed February 13, 1973, Manitoba Gazette).

[13]Other regulations have been passed since. They include regulations respecting litter, passed October 22, 1974; regulations respecting pesticides, passed June 27, 1974; and regulations respecting incinerators, passed December 31, 1974.

them and the regulations can be used as a basis for the examination of benefits and costs with the level of pollution control resulting from these controls.

The emissions must meet specific standards set out by the Commission or by the regulations. The amount of smoke by period of time, the concentration of certain particulates in the air, and the amount of treatment applied to sewage are examples of conditions.

The CEC in most cases does not specify in what way these standards must be met. The standards are outlined and are to be met in whatever way is possible by the corporation or individual. This may result in the alteration of production or in the elimination of part of the production of a firm. This may cause an impact on the activity involved in the form of increased cost of production. The determination of these costs gives some indication as to the usefulness of determining the impacts of standards on business profit.

If the impact is small, then this may indicate that there is no real problem or that the standards which are imposed by the CEC or by specific regulations might be increased to improve environmental quality without substantial additional business costs.

The survey of impacts the CEC actions have on costs gives a first indication of the importance of the problem. From this a benefit-cost analysis will be applied to evaluate the effects of controls on economic activity.

A preliminary survey of the licences issued by the CEC between June 15, 1968 and December 31, 1972 show definite trends in the application of the conditions within the licences. A

summary of the problems associated with contaminants into each of the natural recipients air, land and water has been presented in the first section of this chapter. A summary of the conditions associated with the licences issued by the CEC is included in Appendix A.

Table I indicates to which economic activities the CEC has issued licences and the natural recipients that each activity affects. Groundwater, although it is normally considered as part of the water system along with lakes and streams, is included as part of the land as it is a natural constituent of the soil. The areas that appear to be the areas of greatest concern within the licences are indicated under the column "natural recipient affected by activity."

Environmental Controls in the Provinces Other Than Manitoba

The recent concern over pollution has prompted the revamping of legislation in most provinces across Canada. Most of the provinces have existing legislation to deal with the problems of pollution, but generally the legislation has been scattered in acts that did not deal specifically with pollution abatement. Pollution controls are scattered through legislation dealing with health and welfare and in the areas of resource management. Some provinces have updated existing legislation. In other provinces old legislation has been repealed and replaced by a new consolidated act covering all areas of the environment. In some provinces regulations have been introduced to support the legislation.

TABLE I

ECONOMIC ACTIVITIES AND THEIR EFFECT ON THE NATURAL RECIPIENTS AND COST ESTIMATES ASSOCIATED WITH CONTROLS*

Economic Activity	Number of Licences**	Natural Recipient Affected	Rough Estimate of Capital Costs Associated with Controls for all Firms Licenced ($)
livestock operations (dairy, hogs, & others)	71	land (odour, groundwater)	1,775,000***
solid waste disposal	18	air, land (groundwater)	75,000 (for 1 only)
kennel operation	1	land (odour, groundwater)	25,000
vegetable processing	1	odour	----
incinerators	15	air	275,000 (for 12 only)
chemical plants	3	air (groundwater)	
	2	water (groundwater)	800,000
steam plants	3	air	250,000 (for 1 only)
foundries	3	air	100,000 (for 2 only)
oil refineries	4	air	1,750,000
mining	4	air	
	8	water	3,150,000 (for 9 only)
feedmills	2	air	125,000
metal scrap processing	2	air	225,000

Table I (continued)

Economic Activity	Number of Licences	Natural Recipient Affected	Rough Estimate of Capital Costs Associated with Controls for all Firms Licenced ($)
building products	5	air	825,000
rendering	3	air	225,000
sugar processing	1	air	250,000
sewage treatment plants	51	odour (soil, groundwater)	500,000 (for 14 only)
pulp and paper	2	water	25,000
trout hatchery	1	water	----
water treatment	2	water	----

* This table is a compilation of the sectors that affect each of the natural recipients air, land, and water. The recipient that appears to be of the greatest concern to the Commission is in the third column. This was determined by examination of the conditions within the licences issued. Odour and groundwater appear in brackets in some cases and are problem areas (offensive odours may be released and a possibility of groundwater contamination), but are not the major concern. The cost estimates in the final column were provided by the staff of the Environmental Protection Branch of the Department of Mines, Resources and Environmental Management and are only given to show the magnitude of the costs involved and are not to be taken as accurate costs. The costs in this table are the initial capital costs associated with pollution controls.

Table I (continued)

** The licences issued that are included in this table were issued between June, 1968 and December, 1972.

*** This particular figure appears to be higher than the actual expenditures. Discussions with the personnel of the Manitoba Department of Agriculture and the Environmental Protection Branch of the Department of Mines, Resources and Environmental Management revealed that this estimate is high due to the wording in the questionnare used to determine these costs.

Table II is a summary of legislation that can be used to deal with pollution across Canada. The following discussion concerning legislation throughout the provinces will attempt to make reference to legislative and administrative procedures to control pollution, programs implemented, and the overall relationships to the livestock industry.

The Alberta legislature passed, in 1970, the Environment Conservation Act. Under this act the Conservation Authority was created as a crown corporation. In the act those matters that pertain to environment conservation are wide-ranging and include: (i) the conservation, management, and utilization of natural resources; (ii) the prevention and control of pollution of natural resources; (iii) the control of noise levels; (iv) the economic factors pertaining to the above; (v) operations or activities affecting the quality or quantity of natural resources or the destruction disturbance, pollution, or alteration of the use of the natural resources for their aesthetic value; and (vi) the laws in force in Alberta relating directly or indirectly to natural resources.[14]

Other acts have been passed subsequent to the Environment Conservation Act in which the Environmental Conservation Authority has been given the responsibility of administration. These acts include the Clean Water Act, 1971, the Clean Air Act, 1971, the Department of the Environment Act, 1971, and the Wilderness Areas Act, 1971. Stop order appeal regulations have

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[14]Environment Conservation Authority, First Annual Report 1971 (3, 1971), I, 7.

TABLE II

LEGISLATION CONCERNING THE ENVIRONMENT ACROSS CANADA

Province	Main Acts Concerning the Environment	Bodies Set Up to Administer Environmental Legislation
Alberta	The Environment Conservation Act, 1970 The Clean Water Act, 1971 The Clean Air Act, 1971 Department of the Environment Act, 1971 Wilderness Areas Act, 1971	Environmental Conservation Authority.
British Columbia	Pollution Control Act, 1967 Health Act	Pollution Control Board
Manitoba	The Clean Environment Act, 1968 Public Health Act	Clean Environment Commission
New Brunswick	Water Act, 1970 Clean Environment Act, 1971 Health Act	Water Authority Environment Council
Newfoundland	Department of Provincial Affairs and Environment Act, 1973 The Waste Material (Disposal) Act, 1960 The Waters Protection Act, 1964	
Nova Scotia	Environmental Protection Act, 1973	Environmental Control Council
Ontario	The Ontario Water Resources Act, 1972 The Environmental Protection Act, 1973	Environmental Hearing Board

TABLE II (continued)

Province	Main Acts Concerning the Environment	Bodies Set Up to Administer Environmental Legislation
Prince Edward Island	Act to Establish the Prince Edward Island Environmental Control Commission, 1971	Prince Edward Island Control Commission
Quebec*	Environment Quality Act, 1972 The Public Health Act, 1944 (Regulations for Fox Farms, Pig-Pens, Barns, Stables, Yards and Manure)	
Saskatchewan	The Pollution (By Live Stock) Control Act, 1971 The Water Resources Commission Act The Public Health Act	Saskatchewan Water Resources Commission

*An act respecting protection of the environment was introduced to the National Assembly of Quebec. The first reading of this bill (Bill No. 96) was assented to December 24, 1974. This bill declares that the regulations under the Public Health Act, 1944, are under the Environment Quality Act.

been passed to allow individuals to appeal stop orders issued under the above acts.

No specific regulations have been set up for livestock operations to ensure proper waste management. The Department of Agriculture and the Department of the Environment jointly published a code of practice that may be followed to ensure proper waste management.[15] A livestock operator that follows the code of practice or alternatives accepted by the Department of Agriculture may apply for a Certificate of Compliance.[16] This certificate is not mandatory, but does help to ensure that good waste management will reduce environmental problems.[17]

The development of land for agricultural use and the enhancement of environmental quality come under sections of the Clean Water Act and the Clean Air Act and regulations under the Public Health Act.

The British Columbia legislature passed the Pollution Control Act in 1967. Under this act, the Pollution Control Board was established. The Pollution Control Board acts principally as a policy setting and first stage appeals body over the day-to-day functions of the Director of the Pollution Control Board.

The Pollution Control Board has vested in it certain powers. These include: (i) to determine what constitutes pollu-

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[15] Department of Agriculture and Department of the Environment, Confinement Livestock Facilities Waste Management Code of Practice (September, 1973).

[16] Ibid., 23.

[17] Ibid.

tion of water, land, or air; (ii) to prescribe standards associated with effluent or contaminants released into the air. The discharging of sewage or waste material is not allowed without a permit, under the Act. Permits are mandatory for all proposed new industrial operations and are being required for a steadily increasing backlog of existing operations. They cover discharge to air, land or water. Under the act there are regulations relating to the issuance of permits.

Pollution control objectives are being set up on the basis of industrial groupings. These groupings are: (i) forest products, (ii) mining, (iii) petro-chemical, (iv) food processing and agriculturally oriented industries, and (v) municipal discharges (mainly sewage and garbage disposal). Objectives have been set up for the first three groupings. The last two are in the process of being set up.

Legislation covering the management of farm wastes could come under category (iv). However, although the 1967 Pollution Control Act requires that any operation involved in the discharge of wastes above the ground, below the ground or into a watercourse requires a permit from the Director of Pollution Control, exemptions apply to traditional agricultural operations that are handling animal wastes in a reasonable manner for ultimate use as organic fertilizer on crop land. Some interpretation is necessary to determine what should be considered "tradtional" and "reasonable".[18]

Health officers are responsible for ensuring that operations in their regions do not present a hazard to health.

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[18]Personal communication with the British Columbia Department of Agriculture, Engineering Branch.

Under this authority, health officers have the right to suspend operations that, in their opinion, result in a danger to public health.

Since 1972, poultry producers have been regulating their own sanitation problems through an inspection and advisory program. This program has been successful in handling complaints directed against producers and generally resulted in an improvement in sanitation and waste handling practices on British Columbia poultry farms. Management and design guidelines are currently being prepared for beef, dairy, and swine industries. A Certificate of Compliance Program may be instituted in the future whereby a design certificate may be issued to operations constructed and managed in accordance with the guidelines. It is felt that this approach to regulations by guidelines may be more effective than regulations by laws.[19]

In 1971, the legislature of New Brunswick passed the Clean Environment Act. This act is administered by the Environment Council. The act restricts and limits the discharge into the air of contaminants and the disposal of waste into the soil.

New Brunswick also has the Water Act which is not directly related to livestock, but which prohibits the depositing of contaminants into waters or on ice surfaces.

The Health Act has some regulations that are specific to livestock operations. The transportation of animal waste over public highways is prohibited except in a covered vehicle to prevent spillage or nuisance. Pig or poultry houses cannot

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[19]Personal communication with the British Columbia Department of Agriculture, Engineering Branch.

be built on marshy grounds or land surfaces subject to overflow. Cow yards must be graded, drained and kept clean and wastes must be removed and stored to prevent the breeding of flies.

In Newfoundland, legislation passed in April, 1973 allowed the setting up of the Department of Provincial Affairs and Environment. This department is charged with the responsibility of environmental quality including water, air, and soil quality. Under this act the Lieutenant-Governor-in-Council may make regulations.

In addition to the above act, there is also the Waste Material (Disposal) Act, 1960 and the Waters Protection Act, 1964 that control environmental quality. There are also regulations pertaining to the environment under the Health and Public Welfare Act, 1952 (Public Health (sanitation) Regulations, 1963) and under the Food and Drugs Act (Regulations Governing Milk and Its Products, 1966). These latter two sets of regulations are of specific concern to livestock operations.

In Nova Scotia, a consolidation and expansion of previously existing legislation came about under the Environmental Protection Act, 1973. Until this act, environmental protection was largely the responsibility of the Nova Scotia Water Resources Commission. This legislation and general organization of the Commission did not really lend itself to satisfactory protection of the total environment. Thus the new department was formed replacing the Water Resources Commission. Under this act the Environmental Control Council was formed. It issues certificates of approval in matters concerning the environment. The Environmental Control Council does not have significant regula-

tory powers. The Council examines all the applications for certificates of approval after these have been prepared by the Department of the Environment. These certificates of approval are formal licences to carry out certain projects mainly in the field of pollution control. Examination by the Council is from a policy viewpoint.

The Nova Scotia Department of Agriculture has developed a set of guidelines for use by livestock farmers.[20] At present they are working on a more comprehensive set of guidelines for the Atlantic provinces.[21]

The Ontario Water Resources Act sets up the Environmental Hearing Board and generally governs its activities. The Environmental Protection Act deals with waste management and has sections that deal with the approval of waste management projects and the hearings that are required. To date no hearings have been held on livestock operations.[22]

The Ontario Ministry of the Environment and the Ministry of Agriculture and Food jointly have prepared The Agricultural Code of Practice for Ontario. The use of this code is strongly recommended to assist operators in avoiding situations that

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[20] Structures and the Environment Sub-Committee of the Atlantic Agricultural Engineering Committee, Guide to Animal Manure Disposal in the Atlantic Provinces (Departments of Agriculture, Nova Scotia, New Brunswick, and Prince Edward Island).

[21] Personal communication with the Nova Scotia Department of Agriculture.

[22] Personal communication with the Environmental Hearing Board, Ontario.

could lead to legal disputes concerning pollution. "Farmers operating within the provisions of the 'Agricultural Code of Practice' may expect substantial support in the event of future environmental disputes."[23] The code is intended to be flexible enough to allow special cases of waste management without being overly restrictive.

Prince Edward Island introduced the single agency concept by the implementation of the Environmental Control Commission Act, which established the Environmental Control Commission (ECC) in April, 1971. This act gives control over air, land and water pollution to the ECC, where this responsibility had been spread through a number of government departments.

In its first annual report, the areas of emphasis appear to be on contaminants entering the environment (sanitary sewers, industrial waste) and on wildlife management (fishery programs, upland game, population research, introduction of species, game survey).

There exists no licencing procedure in Prince Edward Island. Certificates of approval are issued for sewage works structures and solid waste disposal areas. In the field of livestock operation the Environmental Control Commission is presently working with the Department of Agriculture to develop some regulations with regard to the operation of such facilities.

If a problem or complaint arises, at present, the Commission contacts the division of Agriculture concerned and attempts to negotiate a satisfactory solution. The administrative

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[23] Ministry of the Environment and Ministry of Agriculture and Food, Ontario Agricultural Code of Practice (April, 1973).

powers of the Environmental Control Commission over animal wastes are directed towards two areas; pollution of streams and obvious odour problems. In these areas, the Commisison can effectively force control. If negotiation of a satisfactory solution is not reached, legal action is taken.

The Quebec assembly passed the Environment Quality Act in 1972. There are no regulations under this act. However, regulations do exist under the Health Act, 1944. There are regulations under this act dealing with livestock operations. In December, 1974 the first reading of a bill to include these regulations under the Environment Quality Act was passed.

A code of practice dealing with new structures and enlargements has been used since August, 1973. Since this date 400 certificates have been issued.

Saskatchewan passed the Department of the Environment Act in 1972. Under this act, the Department of the Environment administers the following acts: the Air Pollution Control Act; the Ground Water Conservation Act; the Water Resources Management Act, 1972; the Water Rights Act; and the Water Power Act. These acts pertain to environmental control in general.

Environmental controls of livestock operations come under the Pollution (by Live Stock) Control Act, 1971. Under this act, a livestock operator must receive a permit before he may construct or alter any operation. In addition, in some cases, the Water Pollution Control Branch reviews applications and if there is a danger of water pollution, the Department of the Environment has the authority under the Water Resources Management Act, 1972 to take the necessary actions. The Land Protection Branch may also review applications where they may

be implications for neighbouring land use or for future development.

To summarize, most provincial legislation has been in effect for only a few years. Changes and alterations are still being made as the end to which this legislation is directed becomes clearer. In most provinces there is a desire for a 'clean' environment. However, the operations being carried out under the recent legislative changes are still in the rudimentary stages. Specific goals and objectives pertaining to the environment do not appear to be clear in most provinces and the introduction of specific controls for livestock and other areas has yet to come.

CHAPTER IV
STUDY OBJECTIVES

Economic activity results in wastes or residuals being produced. Legislation has been implemented across Canada to control environmental degradation that may result from these wastes or residuals. These controls have an impact on economic activity that may alter the activity being examined or the ultimate goals associated with it. The Manitoba government has declared a policy of increased livestock production. If this policy which has associated with it goals of more jobs and higher incomes, is carried out, environmental controls may have a possible effect on it.

There is a need to develop a framework that will relate the controls arising from "environmental concern" to economic activity on a sector basis for Manitoba. The literature review in Chapter III indicated the context within which environmental controls should be analyzed. It demonstrates that economic activity is affected by many influences other than the "tradtional scarcity of resources". One of the main objectives of this study is to develop a framework that relates environmental controls to economic activity and the goals associated with economic activity. Within this framework an analysis may be carried out that could determine the impact that environmental controls have on the economy.

This study examines one particular sector within this framework, livestock operations. An illustrative example of one livestock operation is used and the benefits and costs associated with environmental controls in it are examined and

measured where possible.

This study also includes a review of the general benefits of increasing livestock produciton in the Interlake area of Manitoba. These general benefits are included to complete the framework.

In summary the objectives of this study are as follows:

1) Develop a framework to analyze the effects of pollution controls;

2) Measure the benefits of livestock pollution abatement to an individual farm operator for an illustrative example;

3) Measure the costs of livestock pollution abatement to an individual farm operator for an illustrative example; and

4) Review the general job and income benefits of increasing livestock production in the Interlake area of Manitoba.

CHAPTER V

MODEL AND THEORETICAL BASIS OF ANALYSIS

Benefit-Cost Analysis

A benefit-cost analysis can be used to assess the economic impact of the CEC environmental controls and the regulations set up under the Clean Environment Act.[1] Arising directly from the determination of the benefits and costs is the determination of whether or not the imposition of environmental controls meets the first condition of economic feasibility, that the benefits must equal the costs.

Benefit-cost analysis can be used in three ways: 1) to assess the economic characteristics of a particular project; 2) to determine which of a number of projects designed to serve a given purpose results in the largest ratio of benefits to costs; and 3) to determine which of a number of projects designed to serve different purposes confers the largest net benefits on the economy as a whole.[2]

The first purpose is the most commonly used and is used in this study to analyze the effects of pollution controls on a particular livestock operation. In order to make full use of a benefit-cost analysis the terms, benefit and cost, must be clearly defined.

Benefits can be defined as those effects that are advantageous to whomever they accrue. They result from an action

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[1]Since the regulations controlling livestock operations have come into effect, the CEC does not have direct control over the environmental degradation resulting from livestock operations. A summary of the licences issued by the CEC to livestock operators is given in Appendix A under "Soil Emissions" and the regulations now controlling livestock operations are given in Appendix B.

[2]W.R.D. Sewell, J. Davis, A.D. Scott, and D.W. Ross, Guide to Benefit-Cost Analysis (Ottawa: Queen's Printer, 1965), 3.

that increases the output of useful goods and services. They represent real values. Benefits can be subdivided into primary or direct benefits, secondary or indirect benefits, and intangible benefits.

1) Primary or direct benefits are those gains that accrue to those individuals who make use of the goods and services which are provided by the project or program.

In livestock operations, direct benefits associated with pollution controls include the value of an improved groundwater supply due to improved drainage from feedlots away from groundwater sources. In addition, direct benefits may accrue to residents near livestock operations in the form of reduced emission of offensive odours.

The economic value of these primary benefits is the maximum amount of money that consumers are willing to pay for them, theoretically. The upper limit to this value is the amount that individuals would have to pay for the most efficient alternative source of supply.

2) Secondary or indirect benefits are induced by the project or program being examined. An example of an indirect benefit is increased yields due to the spreading of wastes on arable land.

3) Intangible benefits are those that are not usually bought or sold at a fee and their value cannot be derived indirectly from the price of secondary products produced. Such benefits include cleaner, more aesthetically pleasing surroundings to work within.

Costs may also be divided into primary or direct costs, associated costs, secondary or indirect costs and intangible

costs.

1) Primary costs are those goods and services that must be foregone in order to construct a given project or program. These must not only include expenditures, but also provision must be made for economic losses whether compensated for or not.

2) Associated costs are those that are incurred by the primary beneficiaries of the project and they must be incurred in order to realize the full value of the benefits.

3) Secondary or indirect costs are those costs involved in the produciton of secondary benefits.

4) Intangible costs similar to intangible benefits, are not usually priced in the market.

Measurement of the costs and benefits elaborated above provide a quantitative analysis for assessing the impact of controls on the livestock sector. Economy-wide effects can then be estimated on the basis of the benefit-cost results from the inclusion of other operations and sectors calculated in a similar manner.

Input-Output Analysis

An examination of the entire economy of Manitoba is needed to determine the impact of pollution controls on economic activity. An input-output framework can be used to examine the entire economy. As shown in the review of the related studies (Chapter III), adapted input-output models help demonstrate the relationship that exists between the environment and the economy. It is for this reason that a discussion of input-output analysis is included in this study.

Framingham, MacMillan, and Nickel conducted a study that examined the impact of increasing expenditures in six alternative programs in the Interlake region of Manitoba.[3] The six alternatives included recreation, agricutural livestock, agricultural crops, manufacturing (food and beverage), other manufacturing, and income supplement (welfare). These alternatives were examined by determining what impact the increased expenditures had on the goals of increasing jobs and incomes.

The alternative of particular interest to this study is that of agricultural livestock. Since the Manitoba government has a policy of increasing livestock production and since pollution abatement may have some effect on this policy, a sector analysis of this particular sector could be placed in the context of the entire economy. A review of the results reached by Framingham, Mac Millan, and Nickel allows the impacts to be examined in light of the goals of increased jobs and incomes.

METHODOLOGY

A Framework for Analyzing Pollution Abatement Controls in Manitoba

In order to examine the impacts of pollution controls on an economy-wide basis, a framework can be devised that demonstrates the relationship between economic activity and the environment. A framework is required to place in focus the legislation that has been introduced. The effects of changes in economic activity are then related to the goals set

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[3] C.F. Framingham, J.A. MacMillan, and P.E. Nickel, Guidelines for Community Planning (Winnipeg: Department of Agricultural Economics and Farm Management, University of Manitoba, 1973).

by governments.

Legislation to control pollution has been introduced as a result of concerns raised in recent years relating to environmental degradation.[3] Legislation has been enacted all across Canada and in Manitoba where it took the form of the Clean Environment Act.

Although this legislation is aimed at controlling pollution, it affects other goals that the government may have. Figure 1 is a flowchart that demonstrates the relationships that exist between legislation, economic activity, and the goals that government may wish to achieve through economic activity. The legislation that is introduced and its enforcement may have an impact on economic activity. This impact may be in the form of increased or decreased costs, increased productivity or in some other alteration of activity. By altering the economic activity, the goals associated with economic activity may also be changed. In the case of environmental legislation, the goal is pollution abatement. However, increased costs may reduce incomes or alter the number of jobs available. Further analysis is needed to determine what effect the legislation has on jobs and income.

Although figure 1 indicates that the Clean Environment Act could have an impact on all economic activity and all the

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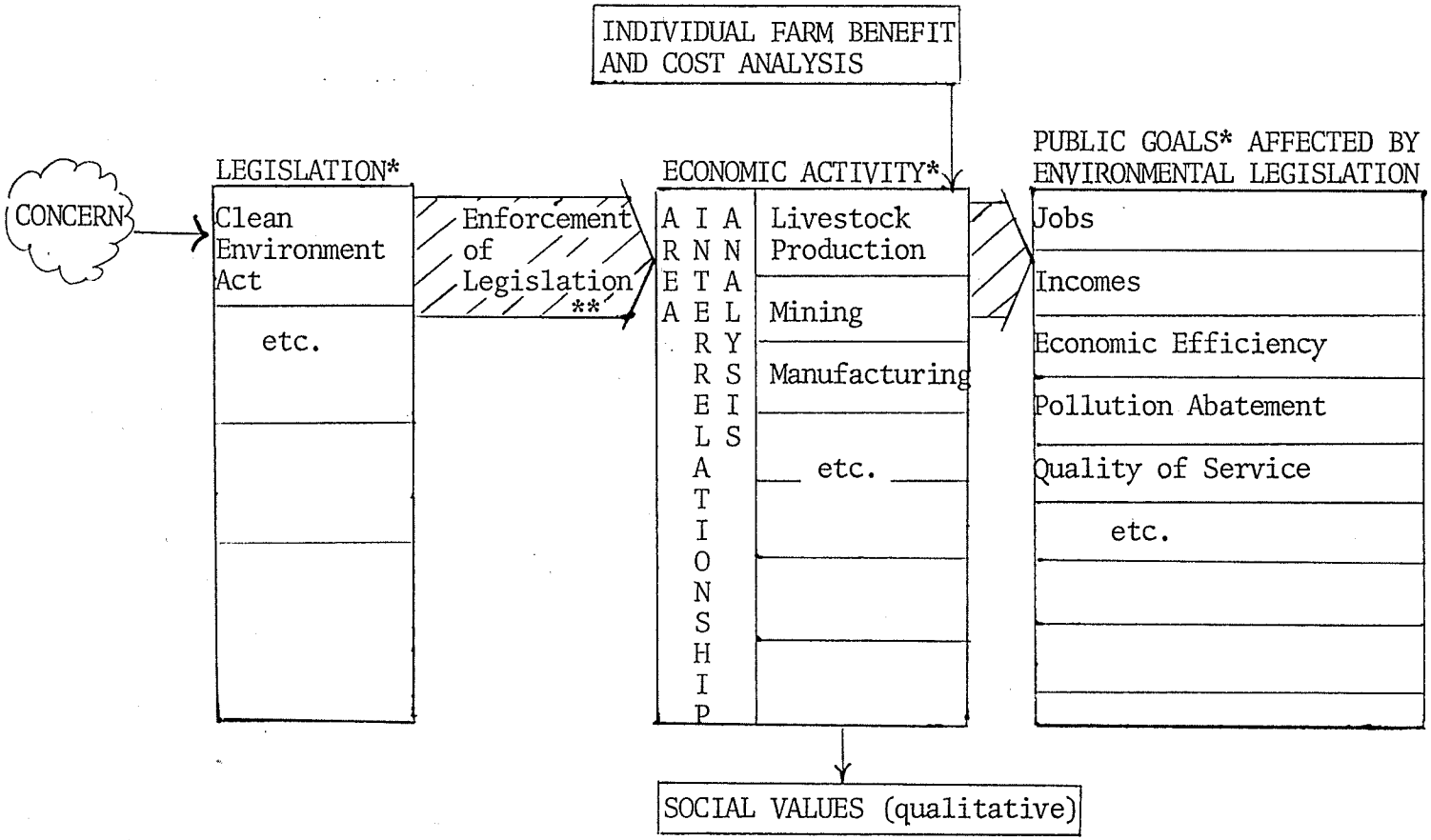
[3]It is recognized that the process involved in bringing about legislation is not simple. However, it is not the intent of this paper to examine this process. Therefore, it is assumed that in a general sense legislation is introduced because of some concern and no further elaboration will be made.

FIGURE 1

FLOWCHART RELATING ENVIRONMENTAL LEGISLATION, ECONOMIC ACTIVITY, AND GOALS ARISING FROM ECONOMIC ACTIVITY



* Each of these steps contain many more acts, activities, and goals. Those that are listed are given to indicate the type of information necessary to conduct an economy-wide analysis.

** Enforcement of legislation is carried out by the expenditure of public funds.

goals associated with it, this study only examines the effects on one activity, livestock production, and on the related effects on jobs and incomes. This analysis is carried out by the use of one illustrative example to demonstrate the applicability of the framework.

The analysis of the effects on jobs and incomes is carried out using the results obtained in MacMillan, Framingham, and Nickel. This study analyzed the impact of injecting $1 million into agricultural livestock produciton. The effects that were indicated in terms of creating jobs and increasing incomes are adapted to the analysis in the study. By determing the benefits and costs of pollution control associated with the single livestock operation examined in this study, individual farm operation direct benefits and costs can be determined subsequently. Inferences can be drawn as to the effects on several similar operations and used as an indication of economy-wide effects.

Benefit-Cost Analysis Applied to Pollution Abatement of a Single Livstock Operation

The previous section dealt with the framework that is used to analyze the economy-wide effects of pollution abatement. This section concentrates on a single livestock operation.

In order to understand the analysis of benefits and costs, a description of the wastes associated with livestock production is included in Appendix C and a description of the alternatives for reducing pollution is included in Appendix D.

The benefits and costs examined in this study are those that accrue to the livestock operation. Although benefits and costs may accrue to neighbouring operations or residences, they are not included.

All benefits and costs, whether direct or indirect, that accrue to the operation should be included. Where possible, values should be attached to the benefits and costs. However, it is recognized that not all benefits and costs are measureable. In these cases, they should be mentioned and given appropriate consideration in light of the analysis.

The actual determination of the benefits and costs of the single operation is carried out by way of a personal interview of the livestock operator. The interview consists of determining the alterations necessary in the operation to meet the requirements set out in pollution legislation. The questions taken into consideration are included in Appendix E. Some of the expected costs include:

1) Capital investments such as the following:
- The paving of lot surfaces.
- The purchase of equipment for handling wastes.
- The installation of gas traps or oxidation equipment to prevent the production of gases.
- The building or alteration of manure storage.
- The construction of catch basins or drainage systems to carry run-off.
- The relocation of existing buildings.

2) Closing down a portion of the operation.

3) The modification of the method of dead animal disposal.

4) Operating costs associated with any alterations in the operation.

Expected benefits include:

1) Reduced incidence of disease.
2) Reduced death losses due to less disease.
3) Less feed consumed due to more comfortable conditions.
4) Reduced bedding requirements due to drier lots.
5) Reduced manure removal costs.
6) Fertilizer value from wastes applied to land.
7) Improved groundwater and surface water quality.

CHAPTER VI
ANALYSIS

Introduction

Figure 1 illustrates the relationships of the framework discussed in Chapter V. This flowchart illustrates how the single livestock operation is placed in the context of the larger framework. The single livestock operation is examined relative to: 1) the legislation that regulates waste disposal; 2) the enforcement of the regulations; 3) the economic relationships in the context of an input-output analysis; and 4) a benefit-cost analysis of the effects of pollution abatement on the single operation. The analysis of the single operation illustrates the use of the framework developed to determine the effects of pollution abatement on the livestock industry.

Illustrative Example

The information contained within this section was obtained by a personal interview with the owner of a feedlot operation. The particular pollution problem associated with this operation was that of contaminating a nearby creek. The situation was remedied by the construction of drainage ditches and a lagoon to prevent drainage into the creek.

This feedlot was licenced for a capacity of 1600 cattle and at the time of the interview there were 900 head. The operation has 13½ acres that are subject to run-off.

The operation had been closed down and in order to reactivate the feedlot, the new operator was required to meet

requirements set out in the regulations regarding livestock operations. The previous owners had drained the feedlot run-off into the nearby creek. The new operator was not allowed to continue this practice.

Through consultation with the Department of Agriculture and the Clean Environment Commission, a drainage system was designed that had the capacity to carry six inches of run-off from the lot area. The drainage system consists of a system of ditches that carry run-off from the lots where the animals are kept to a lagoon. The run-off of greatest concern is the spring run-off. This run-off is held until the summer and is pumped into a nearby field which had a corn crop in 1974.

The costs to the operator associated with this system are as follows:

Capital Costs (construction costs of digging the ditches and the lagoon)	$7,000.00
Annual Operating Costs (rental of pumps, pipes, and other irrigation equipment to remove the water from the lagoon; labour to operate the equipment)	$600.00
Periodic Costs[1] (dry out lagoon and remove sludge)	unknown

There are no benefits associated with this system of pollution abatement. The lot areas are not drier as a result

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[1]The operator gave no indication as to how often this would be done. He stated that every few years the sludge must be removed from the lagoon.

of the system, as drainage from the lots had been carried out before the regulations were imposed upon this feedlot. There is no fertilizer value attributed to the water that is pumped from the lagoon to the nearby field. There appears to be some irrigation value associated with pumping the water to the nearby field. However, this benefit is only a benefit in dry years. In wet years, the addition of water may be a cost.[2]

The regulations regarding livestock operations require that the operator dispose of dead animals in a rendering plant, burying with a minimum of three feet earthen cover, or some other approved manner.[3] The dead animal disposal of this operation is not altered due to the regulations. The animals are rendered when possible and where this is not possible they are buried as required by the regulations.

Expansion of the Livestock Industry

In Guidelines to Community Planning, the analysis of the expenditure of $1 million associated with livestock resulted in the creation of jobs and income. The number of jobs and increases in income were quantified and were given as follows:[4]

Region:

area income generated	$353,000
total farm income	295,000
income per farmer	50
income in trade centre	58,000

[2]The operator mentioned that a larger lagoon may make it worthwhile to install irrigation equipment. He projected that four times the water supply would make it feasible.

[3]Manitoba, Being a Regulation Under the Clean Environment Act Respecting Livestock Production Operations, section 3.

[4]Framingham, MacMillan and Nickel, 45. The region is the Interlake.

jobs in trade centres	11 jobs
Winnipeg:	
income generated	$180,000
jobs generated	43 jobs
Total:	
farm income	$295,000
non-farm income	238,000
jobs	54 jobs

This type of expansion whether it occurred in the Interlake, as in Guidelines to Community Planning, or in the entire province, could create similar effects on jobs and incomes.

Expansion in the livestock industry may be affected by pollution abatement. The increased incomes and the number of jobs created could be altered by pollution abatement expenditures.

The flowchart in Figure 1 shows that economic activity affects the goals of jobs and incomes. Expansion of the livestock industry could affect these goals. In addition, imposition of pollution controls could affect economic activity by changing costs or productivity which in turn, can also affect these. Further analysis is needed to determine the effects of pollution abatement on the expansion of the industry.

The Framework

The framework for analyzing pollution abatement was presented in Chapter V. The flowchart demonstrating this framework presents the relationships between legislation, economic

activity and its goals (jobs and incomes).

The flowchart presents one area that should also be included in the economy-wide analysis. This area is termed social values and has associated with it qualitative goals (aesthetic values, peace of mind and other unmeasureables). These goals should be considered when determining the effects of pollution controls. Although they are unmeasureable, they indicate positive or negative effects where they occur.

Competing economic activities may be affected disproportionately by pollution controls. Feedlots, as opposed to recreational businesses (tourist parks), may have greater costs imposed. A residential development may compete with feedlots in having controls imposed. These effects multiply through the economy. In order to assess these costs accurately, all the reactions should be determined and included.

The environment is composed of various ecosystems. Discharging effluent into a stream not only causes deterioration of the stream, but also any waterbody into which it flows. It may promote algal growth, reduce fish production, and cause various ecological imbalances. Therefore, it is not sufficient to measure just the costs of cleaning the stream, but all costs including fish kills and others.

Each sector has associated with it specific benefits and costs derived from pollution abatement. These may be incorporated into an economy-wide input-output model to develop an economic-environmental model.

The single operation presented incurred only costs from pollution abatement. However, in the larger framework,

benfits accrue to others. Although this study does not analyze the actual benefits and costs to anyone but the operation being examined, it is assumed that benefits accrue to others. Diverting run-off to the lagoon instead of a creek could result in clearer, less odorous water downstream. Further analysis is needed to determine the exact benefits and costs to others, These can then be fitted into the total framework in order to determine the full impact of pollution controls.

CHAPTER VII
RESULTS

Impacts on the Single Operation

The feedlot examined in this study has only costs associated with pollution abatement. The costs are $7000 for construction and $600 per year operating costs. Amortizing these costs over a 20-year life of a feedlot results in equal annual costs of $822.22.[1] The costs of operating the system each year added to the figure give a total cost of $1422.22 per year as the cost of pollution abatement. In terms of the total operation this cost is minimal. Gross revenues for an operation of this magnitude are approximately $300,000.[2] The costs are about 0.5% of total revenues.[3]

If this operation were to expand, in light of the government policy to increase livestock production, the effect of pollution controls on the operator would be non-productive, but negligible. This conclusion assumes that the increased costs of pollution abatement remain in the same proportion to the revenues of the total operation. If costs increase, taking a larger proportion of gross revenues, expansion would not be as

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[1]Using a 10% rate of interest, the amortized cost over 15 years is $920.29 and over 25 years is $771.19 annually. Feedlot life is approximately 15-25 years. Therefore, 20 years was chosen as an average period of life.

[2]This figure was obtained from the operator.

[3]Using 15 or 25 years, this is still only about 0.5% of gross revenues.

productive.[4] Some expenditures would be diverted away from expansion.

If the benefits associated with the controls were greater than the costs, then the effect of spending the same amount of money would be that of increased productivity to the operator.

Economy-Wide Effects of Pollution Abatement

The previous section presents the costs associated with pollution abatement to a single operation. No benefits to the operator results from pollution abatement. The costs are in the form of construction and operating costs of a drainage system.

Although the actual effects of pollution abatement on the entire livestock industry are not analyzed in this study, discussions with personnel from the Department of Agriculture reveal that most operations show no benefits to the operation when pollution abatement is introduced. It was also revealed that little information is available as to the average cost to an operation to carry out requirements of the regulations. Information relating to all the livestock operations in the region is necessary in order to determine the actual effects of pollution abatement. Costs and benefits should be determined for each operation and these should then be combined and analyzed to determine the total effect of controls.

In Table I the costs of pollution control associated with livestock operations is roughly estimated at $1.7 million. These costs appear to be large outlays in terms of pollution

[4]The operator of this operation stated that the cost of constructing a lagoon increased as the depth increased. That is, a lagoon twice as deep as the present one would be more than double the cost.

abatement. If it is assumed that these expenditures are diverted from expansion expenditures, the effects on the expansion could be substantial. However, all operations may not be affected in the same manner. Analysis of the entire industry is needed to determine whate effect pollution abatement has on the expansion of the industry.

The direct effects of the expenditures on pollution abatement are on the construction sector and equipment rental sector. As outlined in Chapter VI, the annual costs consist of equipment rental and some labour. These have only a minor impact on that sector. Similarly, the construction costs would have a minor impact on the construction sector in terms of the single operation.

In terms of the entire industry, it is difficult to state what effects pollution abatement would have from information provided by this on example. Although this example shows that there are construction impacts, it cannot be assumed that the actions of all livestock operations would result in impacts on the construction sector.

The regulations controlling livestock have been in effect only a short period of time (since February, 1973). According to the 1971 census, there were 25,258 farms reporting cattle and/or sheep and/or pigs.[5] The larger operations[6] are

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[5]Most operations reporting livestock appear to be located in sout-western Manitoba. This may give some indication as to where potential impacts of pollution abatement may be large.

[6]The regulations controlling livestock operationsrequire that operations register if they fall under one of seven categories of operation. These categories are defined by the number of Live-

required to register their operations under the livestock pollution regulations. To this date, about 364 operations are registered.[7]

The number of operations that have made alterations is not known. The particular case examined in this study is a larger than average size operation. On a per head basis, the costs are small for pollution abatement. However, in a small operationthe costs would not be proportionately smaller. The cost per head may be larger.

The regulations have not been enforced on all operations. Although all livestock operations must comply with the regulations, not all may make changes. A survey of a representative number and type of livestock operations could be made in order to determine the actual effects of pollution abatement on the livestock industry. This may involve examining representative operations from various regions in the province to determine the provincial-wide effect of pollution abatement on livestock operations.

Impact on the Policy of Expanding the Livestock Industry

In this study it is not possible to determine the effects of pollution control on the expansion of the livstock

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stock Waste Units (L.W.U.) and the proximity to residential or recreation areas. Example: A feedlot operation within a residential area must register if it has more than 29 head of cattle. An operation farther than two miles from a residential area must register if it has more than 695 head.

[7]This figure was obtained from the Environmental Control Board, Department of Mines, Resources, and Environmental Management.

industry. The number of jobs created and income produced would be affected if some money slated for expansion is directed toward pollution abatement. However, the effects on the productivity of the industry in terms od output cannot be determined with only one operation being examined.

The effects of pollution abatement on the operation examined in this study appear to be negligible in terms of diverting dollars to non-productive expenditures. However, the operation examined, is a large operation and as a result of economies of scale was able to apply the costs against a large revenue. Small operations are not subject to these same economies of scale and therefore, the percentage their revenue diveted to pollution abatement may be larger.[8] As a result, the goal of the government to improve the incomes of lower and middle incomes through expansion of the livestock industry could be affected. This would mean that the productivity per dollar spent on expansion would be less than if pollution abatement expenditures were not necessary. Further analysis is needed to determine the actual effect pollution abatement has on the expansion of the industry.

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[8]The total capital costs of equipment may be almost as large for a small operation (150 head) as for a large operation (1000 head) resulting in the cost per head being much greater for a small operator. This information was provided by personnel of the Manitoba Department of Agriculture.

CHAPTER VIII

CONCLUSIONS AND SUGGESTED FURTHER RESEARCH

Conclusions

One of the objectives of this study was to develop a framework to analyze the effects of pollution controls on economic activity. The framework is outlined in Chapter VI. This framework demonstrates the need to examine pollution controls in an economy-wide context, where the impacts on economic activity are related to the goals associated with economic activity. Interrelationships among economic activities exist. These interrelationships result in interdependencies where the actions of one activity may have impacts on others. Similarly, if pollution controls are imposed on livestock operations and no direct benefits accrue to the operator, benefits may accrue to others. The determination of these benefits and/or costs should be undertaken to determine the full impact of pollution controls.

The single livestock operation examined in this study illustrates the use of benefit-cost analysisto analyze one area of economic activity. The analysis of this single operation showed that there were costs associated with pollution abatement, but no benefits accruing directly to the operator. This results in the operator paying for benefits that accrue outside his operation.

Although this single operation had no benefits, this does not lead to the conclusion that there are no benefits associated with livestock pollution abatement. A list of possible benefits are presented in Chapter V. These benefits may accrue to some operations. An analysis of

the entire industry is needed to determine what benefits, if any, do occur related to livestock pollution abatement.

The costs associated with the single operation were small in terms of the scale of the operation. They had minimal effects on the cost of operation.

The effects of pollution abatement on the government policy of increased livestock production are not clear from this study. In the single operation examined, pollution abatement expenditures do not increase productivity. If we assume dollars spent on abatement are diverted from expansion, then expansion is not as great as it would be without the expenditures on pollution abatement. Effects on the entire industry cannot be determined from this study.

The analysis in Guidelines to Community Planning showed that expansion in the livestock industry increased incomes and the number of jobs available in the Interlake area and in Winnipeg. What effect pollution controls would have on this expansion can only be speculated from the information in this study. Analysis of all livestock operations is necessary to determine the effects on expansion of the industry.

Suggestions for Further Research

This study reveals certain areas that require further analysis. The livestock regulations in Manitoba state that no pollution can occur due to their operations. Waste must be retained in the livestock operation. Waste cannot enter any body of water (surface or underground). Dead animals must be disposed in some approved manner. No spillage is per-

mitted when wastes are transported on public roads.[1] All livestock operations are required to follow these regulations. However, enforcement of the regulations may not be possible throughout the province. Enforcement may be the result of complaints by neighbours or the discretion of the provincial departments involved. Therefore, it has been suggested that the uncertainty associated with enforcement may create undue risks which affect livestock enterprise decisions. Some analysis of the way these regulations are being enforced is necessary to determine the magnitude of such effects on livestock operations.

The framework introduced in this study leads to its application on the livestock operations in a region or in the entire province. A survey of a representative number and type of livestock operations could be made to determine the benefits and/or costs associated with pollution abatement on the livestock industry. This may involve examining representative operations from various regions or examining all the operations in a representative region to determine the provincial-wide effects of pollution abatement on livestock operations.

The framework introduced in Chapter V also reveals other areas of further study. Social values, largely qualitative values, should be examined. Their measurement is not always possible. However, in order to determine the true effect

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[1]See Appendix B for the regulations and Appendix A under "Soil Emissions" for the requirements under the CEC licences.

of pollution abatement some measurement is necessary to determine whether these values are affected positively or negatively. These can be included as unmeasureable costs or benefits in the analysis.

The framework also acknowledges that economic activities are not completely separate. There exist interrelationships between activities. Pollution controls may alter the "balance" between the activities. Further analysis is required to determine the effect of these controls on this "balance".

The goals associated with economic activity can be affected by alterations in the economic activity. Further analysis, perhaps similar to that presented earlier in Guidelines to Community Planning, could be undertaken to determine the effect of pollution abatement on the goals of increasing incomes and the number of jobs.

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APPENDICIES

APPENDIX A

SUMMARY OF THE CLEAN ENVIRONMENT COMMISSION LICENCES, JUNE, 1968 to DECEMBER, 1972

The following is a summary of the groups of activities and the conditions that are associated with them.

AIR EMISSIONS

INCINERATORS - The conditions of these licences deal with limitations of the type of wastes, Type I (paper and paper products) or Type II. Depending on the type of waste being burned, there are schedules that outline the type and upper limits of emissions.

CHEMICALS - These licences, where conditions exist, require the emittor to improve his operations and to meet specific emission standards. These standards differ since the type of chemicals involved differ in the case of each company.

STEAM PLANTS - The conditions involved with these licences are outlined in schedules.

FOUNDRIES - The conditions in one case involves the discontinued use of a cupola furnace in one case. In the other case, there are specific emission standards (upper limits) that must be met.

OIL REFINERIES - The conditions in these licences involved the same emission standards in all cases. The concentration of such emissions as SO_2, hydrogen sulfide, fluoride, CO, phenols,

mercaptons, and dustfall, are given upper limits. Sampling and monitoring may be required by the Commission.

MINING - The conditions of these licences have specific limits on emissions. The conditions are slightly different due to different mining and smelting operations. However, where the same emissions are mentioned, the limits are the same.

FEEDMILLS - Where the conditions exist, they pertain to dustfall and to the release of offensive odours.

METAL SCRAP PROCESSING - There are no conditions attached to these excepting a requirement to cease burning after a specific date.

BUILDING PRODUCTS - Where conditions are given, they pertain to the particulate matter in the air (upper limits) and to the amount of dustfall permissable.

RENDERING - The conditions in these licences include controlling offensive odours.

SUGAR PROCESSING - The conditions in these licences include controlling offensive odours and a procedure for sampling contaminants (SO_2 and particulate matter).

It should be noted that a large portion of the licences issued have listed, within their conditions, the controlling of offensive odours (including those that are listed under land

or water emittors). There is no specific criteria for measuring "offensive" odours. It appears that these are considered offensive if there are complaints to the Commission.

WATER EMISSIONS

The following is a summary of the activities that produce water emissions and the conditions that are related to their licences.

SEWAGE TREATMENT PLANTS - The conditions are concerned with the biochemical oxygen demand (BOD) of the effluent. In all cases where it was mentioned, it was the same (couldn't exceed 30 mg per litre). In licences that were issued when the Clean Environment Commission first came into existence, the BOD of the effluent had to be reduced by specific percentages. The BOD of loading the primary or secondary cell range from 34 pounds to 784 pounds per day. (This is probably dependent on the capacity of the cell). Where chlorination is required, it is necessary to have a residual of .5 mg per litre after 15 minutes of contact time. In a few cases, it was required "to an acceptable standard" and fewer cases yet, it may be required at a future date.

In a number of cases no discharge was allowed in the winter months, generally from November 1 to May 15. In some cases, discharges were disallowed from June 15 to September 15.

MINING - The conditions in these licences are mainly requiring the firm to sample the following: arsenic, cyanide, mercury, lead, nickel, copper, zinc, cadmium, total solids, suspended

solids,and suspended volatile solids. The results must be submitted within 60 days to the CEC.

PULP AND PAPER - The conditions in one case are vague and stated in broad terms; the treatment of wastes are to have no deleterious effect on the environment. In other cases, very specific limits are given covering dissolved solids, colour, sulphides, resin acids,and others.

TROUT HATCHERY - The conditions involve the maximum weight of trout in the hatchery and the meeting of the requirements in in a specified schedule.

WATER TREATMENT - The conditions in these licences differ. In one case the concern is with the concentrations of chlorine. In the other case, the concern is with the BOD of the receiving water body.

CHEMICAL PLANTS - The conditions in these cases differ greatly. Both licences have very specific emission limits for various emissions.

SOIL EMISSIONS

ANIMAL OPERATIONS - (including dairies, hog barns, piggeries, feedlots, and others) The conditons in these licences are similar. All mention spreading the solid wastes on arable land according to good agricultural practices. Construction of feedlots and other apparatus are to be carried out to prevent the contamination of groundwater. Dead animals must be incinerated

or disposed of in a manner acceptable to the CEC. In most cases there are limits to the number of animals that are to be kept on the property of the licence holder.

KENNEL OPERATIONS - The conditions within this licence include requiring the licence holder to truck solid wastes from his operation to the municipal disposal ground each day. In addition, there must be no contamination of groundwater.

VEGETABLE PROCESSING - The conditions in this licence involve a limit on the amount of vegetable processing annually and the provision of a settling basin for wastes.

WASTE DISPOSAL GROUNDS - The conditions within the licences for municipal ground usually limit wastes to household wastes. Most licences do not allow burning without permission. Specific requirements for trench digging and grading are included in many cases. This is to ensure good drainage and rodent and pest control.

SEWAGE TREATMENT - The conditions within these licences include prevention of groundwater contamination and some prevent discharge of effluent through the winter months. The BOD loadings on the primary or secondary cells are limited to a specific number of pounds per day and the BOD of the effluent is limited to 30 mg per litre in a number of cases. In some cases chlorination is required. In a few cases the coliform count must be reduced to 1500 per 100 mil.

APPENDIX B

Vol. 102, No. 8 THE MANITOBA GAZETTE February 24, 1973

Manitoba Regulation 34/73

Being a Regulation Under The Clean Environment Act Respecting Livestock Production Operations

(Filed February 13, 1973)

Definitions

1 In this regulation,

(a) "holding pond" means a reservoir, lagoon, cistern, gutter, tank, or area for containing contaminated run-off, effluent or solid waste;

(b) "livestock" means cattle, swine, horses, poultry, sheep, and rabbits not kept exclusively for pets;

(c) "livestock production operation" means an operation where livestock are confined, fed or raised, but does not include:

(i) an operation for the slaughter or processing of livestock;

(ii) an operation for the grading or packing of livestock or livestock products;

(iii) an operation for transporting livestock or livestock products;

(iv) a hatchery; or,

(v) a livestock auction market;

(d) "livestock waste unit" or "L.W.U." means an amount of waste or waste equivalent as set out in Part II of Schedule A;

(e) "prescribed manner for agricultural purposes" means the manner whereby livestock waste is applied onto or introduced into soil from which a crop is grown within sixteen months from the time of application or introduction and from which a crop is harvested within thirty months from the time of application or introduction;

(f) "recreation area" means an area so designated by federal, provincial or municipal authorities;

(g) "residential area" means a city, town, or incorporated village; or other area as designated by the Minister;

(h) "waste" or "livestock waste" for purposes of these regulations, means livestock manure.

General Requirements

2 Livestock production operations are exempt from the requirements of sub-sections 1 & 4 of Section 14 as provided in The Clean Environment Act.

3(1) All waste from livestock production operations shall be disposed of in accordance with the "prescribed manner for agricultural purposes".

3(2) Structures or storages for livestock waste, including manure piles and holding ponds, shall be constructed and maintained so as to:

(a) retain the waste on land under the control of the operator; and,

(b) prevent the waste from entering any body of water.

3(3) All dead livestock from livestock production operations shall be:

(a) rendered in a rendering plant; or,

(b) buried with a minimum of three feet earthen cover; or,

(c) disposed of in some other manner approved by the Minister.

3(4) Any person transporting livestock waste on public roads or right-of-ways shall ensure that no spillage or leakage occurs from the vehicle used.

Registration

4 All operators of livestock production operations falling into those categories set out in Part I of Schedule A shall register the operation with the Minister using a registration form approved by the Minister.

5 All operators of new or proposed livestock production operations falling into those categories set out in Part I of Schedule A shall register the operation with the Minister using a registration form approved by the Minister.

6 All operators required to register under Sections (4) or (5) shall re-register prior to expanding their operations above that for which they have registered.

Coming Into Force

7 This regulation comes into force on the day it is filed with the Registrar of Regulations.

SCHEDULE A

PART I

(Operations and Categories of operations requiring registration)

Any operation:

(a) producing waste in excess of 10 L.W.U. and located within a residential or recreation area; or

(b) producing waste in excess of 50 L.W.U. and located or spreading manure within one-half mile of a residential or recreation area; or

(c) producing waste in excess of 100 L.W.U. and located or spreading manure within one mile of a residential or recreation area; or

(d) producing waste in excess of 200 L.W.U. and located or spreading manure within two miles of a residential or recreation area; or

(e) producing waste in excess of 250 L.W.U., regardless of location; or

(f) producing waste in excess of 100 L.W.U. and located on soils subject to investigation; or

(g) producing waste in excess of 100 L.W.U. and located within one-quarter mile of a residence, other than a residence associated with the operation.

L.W.U. means Livestock Waste Unit.

SCHEDULE A

PART II

Table of Livestock Waste Units – L.W.U.

Type of Operation	Livestock Waste Units
Dairy Cattle	
1 Milk Cow	1.0
1 Milk Cow plus Dry Cows	1.2
1 Milk Cow plus Dry Cows replacement heifers, calves	1.4
Beef Cattle	
1 Beef Animal of Feedlot Capacity	0.36
1 Beef Cow plus replacement heifers, calves (All year Drylot Capacity)	0.7
1 Beef Cow plus replacement heifers, calves (Winter lot Capacity)	0.42
1 Beef Cow plus bulls, replacement heifers, calves (Summer pasture only)	0.28
Swine	
1 Sow (Farrow-Finish) plus boars, replacement gilts, suckling pigs to market	2.0
1 Sow (Farrow-Weanling) plus boars, replacement gilts, suckling pigs to 40 pounds	0.8
1 Feeder Pig (40 pounds to market) Feeder Barn Capacity	0.2
Chickens	
100 Laying hens	0.9
100 Chicken Broilers	0.53
100 Hens in Breeder Flock	1.2
Turkeys	
100 Turkey Broilers	0.85
100 Turkey Feeders	1.5
100 Turkey Hens in Breeder Flock	2.2
Ducks	
100 Ducks	1.0
Geese	
100 Geese	1.1
Horses	
1 Horse	0.5
Sheep	
1 Ewe, plus rams, lambs	0.1
Rabbits	
10 Does, plus Bucks, litters	0.4

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APPENDIX C
EMISSIONS FROM LIVESTOCK OPERATIONS AND THEIR ASSOCIATED PROBLEMS

Animal feedlot wastes generally include the following components:[1]

1. bedding or litter and animal hair or feathers;
2. water and milking centre wastes;
3. spilled feed;
4. undigested or partially digested food or feed additives;
5. digestive juices;
6. biological products of metabolism;
7. microorganisms from the digestive tract;
8. cells and cell debris from the digestive tract wall; and
9. residual soil and sand.

The greatest influence on waste characteristics are animal type, type of housing facility used and diet.[2]

Livestock wastes pose potential pollution problems. Some of the more important hazards that result are the following:[3]

1. gases (odours) from anaerobically stored manure from

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[1] Jeffry D. Denit (project officer), Development Document for Effluent Limitations Guidelines and New Source Performance Standards Feedlots Point Source Caregory (Washington, D.C.: U.S. Environmental Protection Agency, January, 1974), 53.

[2] Ibid.

[3] Canada Animal Waste Management Guide Committee, Canada Animal Waste Guide (1972).

the livestock building itself, and from manure spread over land;

2. water pollution;

3. noise, dust, and pests.

A brief description of the above hazards follow.

GASES - Odours result from anaerobic decomposition of the manure. When stored in a concrete pit, bacteria have little access to oxygen and therefore, decomposition bacteria use carbon and sulfur as acceptors. The gases produced include: ammonia, hydrogen sulfide, methane and others. They are irritant to the human nose and may be harmful. When manure is decomposed by properly designed aerobic systems, the gases are undetectable and harmless.[4]

WATER POLLUTION - Where livestock are concentrated, the land capacity to handle manure can easily be exceeded. When this occurs, the surplus nitrogen is easily leached into the groundwater system. Phosphorous additons to surface water are more likely to be the result of soil erosion due to poor management practices. Very large amounts of phosphorous may result in some reaching streams and lakes. Nitrates are easily carried by leachate and run-off. Feedlots pose a great danger to supplying nitrogen in water.[5]

NOISE, DUST, AND PESTS - Noise from livestock can be a problem

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[4]Paper presented at the Canadian Pork Council Board of Directors Meeting, August 8, 1973 (Toronto), 3-4.

[5]Ibid.

when there are nearby populated areas. Dust is associated with all types of livstock and confinement conditions. It is most serious with housed poultry on litter. Dust may be a physical nuisance and also a carrier of odours and disease-producing organisms. Pests, including birds, flies, and rodents, can be a nuisance and possible carriers of disease.[6]

This section is included to outline the physical aspects of livestock wastes and the subsequent pollution problems arising from it. Social Conflicts arise from these pollution problems. Appendix D discusses the mechanical methods for handling wastes to minimize the social conflict.

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[6]Canada Animal Waste Management Guide Committee, c-2.

APPENDIX D

Alternatives for Reducing Pollution in Livestock Operations

Internal changes to the actual operation can minimize emissions. Methods of waste management that reduce harmful residuals that may affect activities outside th livestock operation may be introduced. The analysis of internal alterations involves an understanding of the systems involved in handling wastes.

Several systems may be used in handling wastes. Each system can be broken into several steps:

1) Removal of wastes and transfer to storage - This includes collection and temporary storage.
2) Storage
3) Removal from storage and transportation to land
4) Land application and incorporation, lagooning and other methods of final disposal

Each step has associated with it problems that may result in social conflicts. The following discussion attempts to describe the physical process, the waste problems and the means of minimizing emissions associated with each step.

1) Removal of wastes and transfer to storage

This step includes the collection of wastes. One of the problems associated with the collection and transfer to storage is that of odour. Odour may be minimized by small collection facilities and frequent removal to storage. In some cases collection and storage are combined. Slotted floors are used in many

poultry and some swine operations, where wastes fall through to a storage pit.

The method of transfer to storage is dependent on the consistency of the manure. Mechanical equipment scrapes, conveys and stockpiles manure when solid manure is handled.[1] In liquid systems, manure can be transferred by gravity flow in deep gutters or by mechanical scrapers.[2] In systems that allow storage below the collection areas, flows are usually by gravity. Dangerous gases may be produced in such a system. A gas trap installation or a continually running exhaust fan will provide protection from gases. Storage above the collection area requires transfer pumps.

2) Storage

Storage of manure helps to eliminate daily disposal of manure and facilitates application of manure on land at optimum times for crop utilization. Criteria that are desirable for storage types are watertight, easily emptied, and sufficient capacity. Manure in storage, unless aerated, undergoes anaerobic bacterial breakdown resulting in noxious gases being produced. An odour nuisance as well as a hazard due to toxic gases can be created.

Catch basins are used in some systems. These are used to intercept run-off from livestock areas.

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[1]Alberta Department of the Environment and Department of Agriculture, Confinement Livestock Facilities Waste Management Code of Practice.
Solid manure is defined as manure undergoing some drying or containing bedding to the extent that a stiff, non-flowing material is obtained (15-25% dry matter).

[2]British Columbia, Animal Waste Management Guide, (1971).
Liquid manure is defined as containing 2-8% dry matter. Semi-solid manure is defined as containing 10-15% dry matter.

Lagoons are another method of storing wastes. Anaerobic lagoons are subject to odour problems. Lagoons, therefore, should be located carefully. They should be far enough from a residential area to avoid a nuisance and on the leeward side of the farm house. Consideration should be given to expansion of the lagoon. Surface drainage to the lagoon from adjacent areas should be avoided. Surface and groundwater contamination should be avoided by having an impervious liner on the lagoon in lighter soils.

Mechanical aeration can be introduced into a system in the form of an oxidation ditch or an aerated lagoon. One of the major advantageous of aeration is the reduction of noxious odours. It may reduce waste (solid) volume and flies.

3) Removal from storage and transportation to land

Equipment is readily available for transportation and spreading solid and liquid manure on land. To handle semi-solid wastes, special equipment is necessary. Odour problems arise in this step also. When removing wastes from storage, gases are released.

4) Land application and incorporation and other methods of final disposal

There are a number of ways wastes can be disposed. Land application is the oldest and most widely used method. Other methods include dehydration, incineration, composting, and refeeding.

Dehydration is a difficult and expensive process. The market for dried manure is limited. Raw manure has approximately 15% dry matter and 85% water and a great deal of energy is

needed in the drying process. After burners are required to prevent air pollution.[3]

Incineration also has problems. It reduces solids, but large amounts of heat are required. Odours and gas may become objectionable to neighbours and therefore, must be controlled.[4]

Composting is suitable to low moisture content manure. Oxygen must be present at all times to supply bacteria needs, 1-2% nitrogen must be supplied, 50% moisture maintained and 140° F. temperature must be maintained. Piles require frequent turning to supply oxygen. Composting requires time and equipment beyond the scope of many producers.[5]

Lagoons are used for storage and may also be used for final disposal of wastes. Lagoons offer advantages to the operator. They require little attention, can be used all year round, and require moderate capital cost and very low capital cost. They, however, are generally unsightly, may be alightly odorous and all nutrients are lost if contents are never spread on the land.[6] There may also be a danger of groundwater contamination if they are not constructed properly.

Returning manure to the land is a widely used method of final disposal. A large quantity of nutrients and organic matter are saved with this method. Problems may arise with the use of this method over a period of years. It can result in a

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[3] Ibid., 19.

[4] Ibid.

[5] Ibid.

[6] Structures and Environment Sub-Committee of the Atlantic Agricultural Engineering Committee, Guide to Animal Manure Disposal in the Atlantic Provinces (Departments of Agriculture of Nova Scotia, New Brunswick, and Prince Edward Island), 7.

high build-up of nitrate in the soil at exceptionally high rates of application.

For the most efficient use of nitrogen from the manure, soil incorporation as soon as possible after application is necessary.[7] This also reduces odours that may result from application. If soil injection is used, immediate odour control is possible. Manure should not be applied to snow as there is a danger to run-off to open watercourses in the spring.

In addition to handling wastes produced by livstock, operators must also be concerned with another waste product of their operations, dead animals. Dead animals can be incinerated, rendered or buried. Their proper disposal ensures the prevention of disease spreading and the production of odour nuisances.

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[7]Alberta Department of the Environment and Department of Agriculture, 19.

APPENDIX E

QUESTIONS TO DETERMINE THE BENEFITS AND COSTS ASSOCIATED WITH POLLUTION ABATEMENT LEGISLATION RELATING TO LIVESTOCK OPERATIONS

Questions related to expected costs:

Were there any alterations to your operation in order to meet pollution abatement requirements set out by the law?

If there were any alterations, did they require capital investments such as the following?

1. Were lot surfaces modified (i.e. paved) in order to allow the collection of animal wastes?
2. Was it necessary to purchase any equipment to pile or remove manure from buildings or lots?
3. Was equipment installed to prevent the production of annoying or dangerous gases?
4. Was it necessary to build or alter storage requirements for animal wastes?
5. Were any catch basins or drainage systems constructed to carry run-off around livestock housing and lot areas?
6. Were any existing buildings moved to a new location due to consideration of odour, run-off, or other related reasons?
7. Were any portions of the operation closed down?
8. Was dead animal disposal modified?
9. Were there any other changes made other than the above?

If so, what were they?

If any equipment was installed, over what period of time will this equipment last?

What were the capital costs of each of the changes made?

What were the annual operating costs of the changes?

Questions related to expected benfits:

Did the alterations made have effects such as the following:

1. Veterinary bills; were they higher, lower, or the same after pollution abatement alterations were made?

2.Death losses; were they higher, lower, or the same?

3. Feed consumption; was it higher, lower, or the same?

4. Bedding requirements; were they higher, lower, or the same?

5. Manure removal cost; was it higher, lower, or the same?

6. Weight gain; did the animals gain weight in a shorter, longer, or same period of time?

7. Were any wastes applied to the land as fertilizer? If yes, was this done before the pollution abatement alterations were made?

8. Groundwater; did groundwater quality change or remain the same since the installation of any pollution abatement equipment?

9. Surface water (creeks, rivers, etc.); have any nearby waterways changed in quality due to the control of spring run-off and of run-off due to rain?

10. Were there any other changes that could be attributed to pollution abatement installations?