What the Environmental Commissioner Said:
The Federal Report Card on Agriculture In Ontario and Quebec

SPECIAL REPORT

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On October 2nd, 2001 the federal environment commissioner released her annual report. In it, she offered an assessment of the environmental impact of agriculture in the Great Lakes basin and the federal government's role. Specifically, the environment commissioner addressed:

* Manure and fertilizer management
* Soil erosion
* Environmental impact of farm programs
* Federal role in sustainable agriculture.

Based on environmental audits and other analyses, the commissioner presented the following conclusions:

* There is a problem with the accumulation of soil nutrients as a result of manure and chemical fertilizer applications in the Great Lakes basin
* Soil erosion is a continuing problem that is not receiving adequate attention or data collection
* Agriculture and Agri-food Canada (AAFC) has not adequately taken account of the environmental impact of farm programs, and farm programs can have impacts that conflict with AAFC's stated environmental goals
* AAFC has not appropriately targeted funding for the environment by region, and there is a greater need for cross-compliance in farm programs
* Certain agricultural practices are unsustainable, and the framework to alter unsustainable farming practices is lacking.

But are these conclusions warranted, given the mix of belief and credible evidence that typically permeates discussions of agriculture and the environment? In this special report, we provide a brief analysis of the Environment Commissioner's report as it relates to livestock and sustainability. Specifically, we clarify a misconception in the Commissioner's comparison between livestock waste and human waste, and discuss the sustainability of crop nutrients (loadings and uptake) in Ontario and Quebec as they relate to manure loadings and fertilizer use.

Livestock and Sustainability

The legacy of the commissioner's report will almost certainly be its confusing message on manure and sustainability. The report claims that:

* "Livestock operations in Ontario and Quebec generate enough manure to equal the sewage from over 100 million people. And the problem of how to manage it safely is getting worse. While the number of cattle is slowly decreasing, hog and poultry numbers are growing, particularly the number of animals on each farm"
* "A more recent cause [of soil and water contamination] has been the increasing concentration of livestock production. Much of the manure these animals generate is spread on agricultural land. Manure can have a greater impact on downstream water than fertilizer because manure is applied in a higher concentration to a smaller area. The result is that inorganic nitrogen is accumulating on farmland in the basin. Roughly 70 percent of Ontario and Quebec farmland had much higher nitrogen levels in 1996 than in 1981—and much of it above levels that cause groundwater and surface water contamination. Runoff from the soil has also increased nitrogen levels in the water on up to 77 percent of the basin's farmland, and downstream".

The first of these statements is a comment on the absolute volume of manure produced, the second relates to the sustainability of current livestock numbers and fertilizer use.

Let's look at each of the two in some detail.

Do Farm Animals Create as Much Waste as 100 Million People?

The Environment Commissioner bases her conclusion about relative amounts of waste generated by comparing the amount of *solids* in human and farm animal waste. But she talks about it as if she was comparing it on a *volume* basis. This analogy between livestock and human waste is quite misleading because human waste and animal waste are very different and are handled entirely differently. The nature of human sewage treatment processes, and of modern human lifestyles, is that they use large quantities of water that cannot be recovered or reused. Human sewage treatment processes require large amounts of water to function correctly, while livestock manure handling technology does not. Human sewage, because of the other things that are mixed with it includes heavy metals. Although trace amounts of heavy metals can be found in livestock waste, it is typically much less.

The amount of solids may be an appropriate measure on which to compare nutrients; however, it is not the appropriate basis upon which to compare the volume of livestock and human waste because humans use so much more water. The correct way to directly compare livestock and human waste is to measure actual volumes, rather than solids. But because the Environment Commissioner measures *solids*, but then makes an inference about the *actual volumes* of waste produced by livestock and humans, her comparison is off by many factors of magnitude.

To make an accurate comparison, the actual *volume* of waste (manure and water) by livestock species must be summed and compared with the total volume of waste produced by a human. Table 1 below gives the volume of manure and wastewater for major livestock categories and humans, along with the most recent (July and August, 2001) livestock inventory for Ontario and Quebec. The table shows that the total daily waste produced by livestock in the two provinces is about 194 million litres. When adjusted to compare with the waste volumes of a human population, this is equivalent to approximately 854,010 people, not 100 million. In other words, the Environment Commissioner has overestimated by almost 120-fold the number of people really equivalent to the manure volume of the livestock inventory in Ontario and Quebec. It is clear that the comparison based on solid manure production vastly overestimates the actual volume ratio, but yet it is used to support a claim related to actual volume. This egregious error in the Environmental Commissioner's report makes her conclusion quite incorrect, and more than a little impertinent. .

Is the Farm Animal Population Sustainable?

Let's look now at the second question. In addition to the inherent misrepresentation in the Commissioner's comparison, the relative equivalence of human and livestock waste has no obvious relationship to sustainability. By itself, whether livestock waste is equivalent to 100 million or 0.85 million people, it says nothing about sustainability.

A sustainable concept around livestock is that the nutrients produced from manure and applied to the land ought to be no greater than the nutrients taken up by crops produced by the land. The total uptake of soil nutrients by major field and horticultural crop in Ontario and Quebec is presented in Table 2 based on estimated acreage and recommended fertility rates.[1] Table 3 presents the amount of nitrogen and phosphorous excreted by livestock on an annual basis, given the July (hogs and beef) and August 2001 (chicken) inventory (as compared to the 1996 livestock inventory used in the commissioner's report). These were generated by assuming the number of animals reported on the date of the inventory report is representative of the actual steady state population of animals throughout the year.

In Table 4, the demand for nutrients from field crops is compared with the supply from manure. These estimates do not include the uptake of nutrients by pastures, an obviously important amount for dairy and beef cows. They also do not make any adjustment for manure that is processed into compost. What the data show is that, at a provincial level, crops require more nutrients than could possibly be provided by livestock manure. The table shows that phosphorus is the nutrient closest to being in excess from livestock sources, but crops still consume roughly 74,000 tonnes more phosphorus than is supplied by manure. In fact, 76% of the phosphorus demand from crops could be supplied from manure. The phosphorus balance is closer in Quebec, at 91%, and is 67% in Ontario. Nitrogen generated from livestock is actually far lower than crop demand (37% for the

[1] The nutrient uptake is actually understated because we lack data on pasture acreage in Ontario and Quebec. Also, no one knows how much manure is composted. So, the nutrient production is overstated.

two provinces). Even when the removal of nitrogen by soybeans is ignored, the nitrogen demand is about 365 thousand tonnes in excess of manure loadings.

However, this is not by itself a defense of the current levels of livestock intensity and sustainability, because the sustainable criteria must be met on a site-specific basis. And, obviously, farmers also apply chemical fertilizers in addition to the manure from livestock. The Environment Commissioner notes that 1.26 million tonnes of fertilizer were applied in the Great Lakes basin in 1998. Given this magnitude, it is certainly possible that the combined effect of manure and fertilizer applications generate a net surplus of nutrients in Ontario and Quebec soils, particularly of phosphorus. This would be consistent with the Environment Commissioner's finding that farmers are not using best management practices. For example, if farmers tested the nutrient content of manure they could reduce their use of chemical fertilizers. It also underscores the need for soil tests prior to fertilizer applications.

However, on this issue, the Environment Commissioner's information is out of date. The number of soil tests conducted in Ontario increased from 43,000 to 156,000 between 1992 and 1999, suggesting that farmers' adoption of best management practices is improving[2]. The data also show that chemical fertilizer use generally, and phosphate fertilizer use in particular, is in decline. This is illustrated in Table 5, which shows that in the year ended June 2000, approximately 64,000 tonnes of phosphate was applied from chemical fertilizer sources in Ontario. Based on the current livestock inventories and crop demands in Table 4, Ontario is deficit about 64,000 tonnes of phosphate. Thus, phosphate applications in Ontario almost exactly offset the deficit. Based on crop demands relative to manure nutrient loadings, Quebec is deficit about 9,400 tonnes of phosphate. However, Table 5 shows that almost 50,000 tonnes of phosphate were applied in Quebec, which exceeds the demand of major crops. Again, recall that neither pasture nor compost are included in the estimates.

From a sustainability standpoint, nitrogen and phosphorus present two very different stories. Manure loadings of nitrogen are nowhere near crop demand at the provincial level, even with adjustments for soybeans as legume (nitrogen fixer). On the other hand, manure loadings of phosphorus <u>are</u> close to crop demands. Accounting for chemical fertilizer applications, combined manure and fertilizer applications are exactly in balance in Ontario and are slightly in surplus in Quebec. Thus, the binding sustainability constraint is phosphorus.

The foregoing does not indicate that, at the provincial level, current livestock numbers are unsustainable. Based on current livestock numbers, we are still deficit of nutrients in Ontario and Quebec. If manure is used wisely (exchanged and allocated across farms), little chemical fertilizer would be required to meet current crop demands for phosphorus. In fact, if manure were transported across a province, thus relaxing the need for nutrient balance on a site-specific basis, (and reducing the need for chemical fertilizers) it shows that current livestock numbers are quite sustainable. Finally, no explicit mention is made in the Environment Commissioner's report of soil organic matter. In some areas, relative

[2] Source: Ontario Agribusiness Association

lack of livestock has resulted in more reliance on chemical fertilizers for required soil nutrients. While chemical fertilizers supply nutrients, they are not a rich source of organic matter for the soil, so areas without a supply of manure as a fertilizer tend to develop deficiencies in soil organic matter. Thus, there is a natural gain in organic matter if manure is reallocated from higher intensity livestock regions to lower intensity livestock (relative organic matter deficient) areas.

Conclusions

The statements made by the Environment Commissioner about the volume of livestock manure relative to those from a human population are bound to scare the parliamentarians she reports to along with others who read her report. On this comparison, she is implicitly assuming her readers can make the conversion between actual waste volumes and solids, and that the comparison will be interpreted correctly. In fact, most readers of the report won't know the solids content of the waste materials, let alone make the mental conversion in their interpretation. Moreover, most will not understand that human waste is a costly problem that needs to be treated, while animal waste is a rich source of nutrients that is used to produce crops. Consequently, the dubious comparison between livestock and human waste will be misquoted in arguments about livestock and the environment in the future.

As well, the sustainability of livestock in Ontario and Quebec has been misrepresented. On a nitrogen basis, there is no evidence whatsoever that the current livestock population is unsustainable. On a phosphorus basis, the aggregate amounts are close to being in balance. Particularly in Quebec, chemical applications of phosphorus appear to overcompensate for the gap left between nutrient demand from crops and the supply from manure. While phosphate applications are declining in both Ontario and Quebec, this excess deserved to be addressed in the Environment Commissioner's report. At the same time, the important point here is that the supply and demand of phosphorus is very close to being in "balance", and balance would seem to be a good definition of sustainable.

It is always easy to criticize a major research undertaking like the Environment Commissioner's Report to Parliament. She has a very broad mandate (far broader than just agriculture) and has many findings to report. With respect to livestock, she chose to evaluate evidence on the basis of "sustainability". However, in this regard, an opportunity was passed to clearly outline the criteria that should be met for livestock to be sustainable, to evaluate whether agriculture is meeting the criteria, and then, based on the criteria and the evidence, to suggest what the federal government needs to do to promote and ensure sustainability. Had this been done, it might have been more obvious that phosphorus is the real livestock sustainability issue, and that policy instruments should be targeted to address it. Instead, the commissioner did not clearly establish her sustainability criteria, and made criticisms that will be interpreted as hostile rather than constructive by the agricultural community. This is unfortunate, because she makes valid criticisms related to the outdated database used to address environmental problems in

agriculture, the need to more accurately target federal programs, and the requirement for cross compliance between environmental and income support programs.

The timing of this report is appropriate, but will at the same time add controversy to an already lively debate. In Ontario, Quebec and Alberta, legislation is in process that addresses issues of livestock and the environment. The numbers quoted by the Environment Commissioner will be used selectively by opponents and proponents of legislation to support their positions. One of the purposes of this analysis has been to clarify an area in which the Environment Commissioner's findings will not provide assistance in locating helpful solutions. At the same time, the discussion of the adequacy of databases and evaluation of policy instruments will help establish criteria against which the regulatory responses to problems in Ontario, Quebec and Alberta can be measured.

Table 1 Volume of Manure/Wastewater for Major Livestock Categories and Humans

	Daily Volume of Manure and Wastewater* (Litres/hd)	**Ontario Inventory ('000 Head)**	**Quebec Inventory ('000 Head)**	**Total Daily Volume of Manure/Wastewater Produced in Ontario and Quebec ('000 Litres)**
Beef Cattle	21.3	1,538	709	47,861
Dairy Cattle	68.7	547	602	78,936
Hogs	5.8	3,102	3,808	40,074
Broilers	0.07	188,675	157,012	24,198
Layers	0.2	9,250	4,705	2,791
Total Livestock				**193,860**
Human	227			
Implied Human Population to create Animal Waste Equivalent				***854,010***

* including dilution liquid

NOTE: The Fleming and Ford study (2001) did not contain a daily volume of manure and wastewater value for turkeys. As a result, if the turkey waste were included the implied human population to create the equivalent animal waste would increase modestly.

Source: Fleming and Ford, 2001, CANSIM, 2001 and Statistics Canada, 2001.

Table 2 Estimated Acreage and Recommended Fertility Rates for Field and Horticultural Crops

	Nutrient Requirement (kg/ha)		Area Seeded* ('000 ha)	ON (tonnes)		Area Seeded ('000 ha)	QUE (tonnes)		TOTAL (ON&QUE) (tonnes)	
Crop	**N**	**P_2O_5**	**Ontario**	**N Uptake**	**P_2O_5 Uptake**	**Quebec**	**N Uptake**	**P_2O_5 Uptake**	**N Uptake**	**P_2O_5 Uptake**
All Wheat	168	59	265	44,527	15,585	37.2	6,251	2,188	50,778	17,772
Corn for Grain	230	104	789.1	181,207	81,764	430	98,744	44,555	279,951	126,319
Soybeans	291	50	870.1	253,414	43,860	150	3,687	7,561	297,101	51,421
Barley	112	42	113.3	12,692	4,759	148.5	16,635	6,238	29,326	10,997
Oats	87	36	32.4	2,813	1,180	85	7,379	3,095	10,192	4,274
Canola	157	76	14.2	2,227	1,074	5	784	378	3,011	1,452
Tame Hay	207	48	930.8	192,893	44,313	810	67,859	38,562	360,752	82,876
		TOTAL FIELD		**689,772**	**192,535**		**341,339**	**102,577**	**1,031,111**	**295,112**
	Nutrient Requirement (kg/ha)		**Area Seeded* ('000 ha)**	**ON (tonnes)**		**Area Seeded ('000 ha)**	**QUE (tonnes)**		**TOTAL (ON&QUE) (tonnes)**	
Horticulture	**N**	**P_2O_5**	**Ontario**	**N Uptake**	**P_2O_5 Uptake**	**Quebec**	**N Uptake**	**P_2O_5 Uptake**	**N Uptake**	**P_2O_5 Uptake**
Potatoes	246	78	17.7	4,352	1,385	19	4,681	1,489	9,033	2,874
Tomatoes	258	98	7.4	1,907	726	0.6	149	57	2,056	782
Tobacco	109	25	22.3	2,433	561	0	0	0	2,433	561
Cabbage	277	84	1.8	492	149	2.3	642	195	1,135	344
Carrot	162	28	2.7	444	77	3.4	560	97	1,005	173
Onions	148	45	2.3	338	102	1.8	266	80	604	182
Apple	112	56	9.7	1,089	544	7.5	839	420	1,928	964
Peaches	56	22	2.3	130	52	0	0	0	130	52
Grapes	56	22	6.3	354	142	0.1	7	3	361	144
		TOTAL HORTICULTURAL		**11,540**	**3,738**		**7,145**	**2,340**	**18,684**	**6,078**
		TOTAL FIELD AND HORT		**701,312**	**196,272**		**348,483**	**104,917**	**1,049,795**	**301,189**

Numbers may not add up due to rounding.

Source: Canadian Fertilizer Institute, 2001 and Statistics Canada Field Crop Reporting Series, 2001.

***** For perennial crops, includes new seedings and stands established prior to the growing season

Table 3 Amount of Nitrogen and Phosphorus Excreted by Livestock on an Annual Basis, Tonnes

			Ontario			Quebec				
HOGS	**N kg/day**	**P_2O_5 kg/day**	**July 2001 Inventory ('000)**	**Total N Dep (tonnes)**	**Total P_2O_5 Dep (tonnes)**	**July 2001 Inventory ('000)**	**Total N Dep (tonnes)**	**Total P_2O_5 Dep (tonnes)**	**TOTAL N (ON&QUE)**	**TOTAL P_2O_5 (ON&QUE)**
BOARS	0.041	0.029	13.1	195	139	8.7	130	92	325	231
SOWS	0.032	0.023	342.9	3,973	2,838	362	4,195	2,996	8,168	5,834
< 45LBS.	0.009	0.005	919.5	3,044	1,826	1,205	3,989	2,394	7,033	4,220
45 TO 130 LBS.	0.014	0.010	949.1	4,713	3,456	1,141.1	5,667	4,156	10,380	7,612
> 130 LBS.	0.041	0.030	877.1	13,067	9,728	1,090.8	16,251	12,098	29,318	21,825
Total			**3,101.7**	**24,993**	**17,987**	**3,807.6**	**30,231**	**21,735**	**55,224**	**39,723**
POULTRY										
	N kg/day	**P_2O_5 kg/day**	**July 2001 Inventory ('000)**	**Total N Dep (tonnes)**	**Total P_2O_5 Dep (tonnes)**	**July 2001 Inventory ('000)**	**Total N Dep (tonnes)**	**Total P_2O_5 Dep (tonnes)**	**TOTAL N (ON&QUE)**	**TOTAL P_2O_5 (ON&QUE)**
Broilers	0.00077	0.00041	188,675	53,094	28,109	157,012	44,184	23,392	97,278	51,500
			Aug 2001			Aug 2001				
Layers	0.00132	0.00113	9,250	4,440	3,828	4,705	2,259	1,947	6,699	5,775
Turkey	0.00140	0.00074	8,732	4,458	2,360	4,914	2,509	1,328	6,966	3,688
ALL CATTLE										
	N kg/day	**P_2O_5 kg/day**	**July 2001 Inventory ('000)**	**Total N Dep (tonnes)**	**Total P_2O_5 Dep (tonnes)**	**July 2001 Inventory ('000)**	**Total N Dep (tonnes)**	**Total P_2O_5 Dep (tonnes)**	**TOTAL N (ON&QUE)**	**TOTAL P_2O_5 (ON&QUE)**
BULLS	0.270	0.109	25	2,462	993	18	1,773	715	4,235	1,708
BEEF COWS	0.195	0.141	405	28,828	20,783	220	15,659	11,289	44,487	32,072
BEEF HEIF.-BREED.	0.154	0.113	75	4,221	3,104	37	2,082	1,531	6,303	4,635
BEEF HEIF.-SLGH	0.195	0.141	146	10,392	7,492	14	997	718	11,389	8,210
STEERS	0.195	0.141	285	20,286	14,625	63	4,484	3,233	24,770	17,858
CALVES	0.077	0.059	602	16,941	12,955	357	10,046	7,682	26,987	20,637
Dairy										
	N kg/day	**P_2O_5 kg/day**	**July 2001 Inventory ('000)**	**Total N Dep (tonnes)**	**Total P_2O_5 Dep (tonnes)**	**July 2001 Inventory ('000)**	**Total N Dep (tonnes)**	**Total P_2O_5 Dep (tonnes)**	**TOTAL N (ON&QUE)**	**TOTAL P_2O_5 (ON&QUE)**
MILK COWS	0.270	0.109	371	36,541	14,739	431	42,450	17,123	78,991	31,862
MILK HEIFERS	0.193	0.077	176	12,382	4,953	171	12,030	4,812	24,412	9,765
TOTAL LIVESTOCK				**219,037**	**131,927**		**168,704**	**95,506**	**387,741**	**227,433**

Numbers may not add up due to rounding.

Source: ASAE, 1992, CANSIM, 2001 and Statistics Canada, 2001.

Table 4 Demand for Nutrients and the Supply From Manure in Ontario and Quebec, Tonnes

	Ontario		Quebec		Total Ontario & Quebec	
	Nitrogen	Phosphate	Nitrogen	Phosphate	Nitrogen	Phosphate
Agronomic Requirement	701,312	196,272	348,483	104,917	1,049,795	301,189
Livestock Nutrient Production	219,037	131,927	168,704	95,506	387,741	227,433
Net (livestock supply – agronomic demand)	-482,275	-64,345	-179,779	-9,411	-662,054	-73,756

Table 5 Fertilizer Sold and Nutrient Content (Ontario and Quebec)

ONTARIO[3]			
Year	**Total**	**Nitrogen**	**Phosphate**
Ending	**Fertilizer**	**(N)**	**(P_2O_5)**
2000	699,986	158,500	64,340
1998	*782,639*	*171,971*	*75,154*
1995	762,694	174,630	79,860
1990	889,023	190,013	97,954
1985	1,162,175	237,409	152,021
QUEBEC[4]			
Year	**Total**	**Nitrogen**	**Phosphate**
Ending	**Fertilizer**	**(N)**	**(P_2O_5)**
2000	429,932	94,719	49,809
1998	*459,238*	*96,464*	*58,314*
1995	422,438	84,347	57,052
1990	507,599	95,245	73,381
1985	498,785	83,315	73,801

[3] Source: Ontario Agri Business Association. These data are slightly different from those published by Korol and Rattray, who extend these numbers to account for liquid starter fertilizer applications. However, their procedure structurally overestimates the amounts of total fertilizer, nitrogen and phosphate, and since it is not obvious how the adjustment can be made correctly, our analysis applies the actual data supplied to Korol and Rattray by the Ontario Agri Business Association.

[4] Source: Korol and Rattray. Because Korol and Rattray do not make estimates of liquid starter fertilizer volumes in Quebec, the above issue is avoided

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