



Agriculture and
Agri-Food Canada

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Task Force on Reactive Nitrogen

26 March 2014, Madrid, Spain



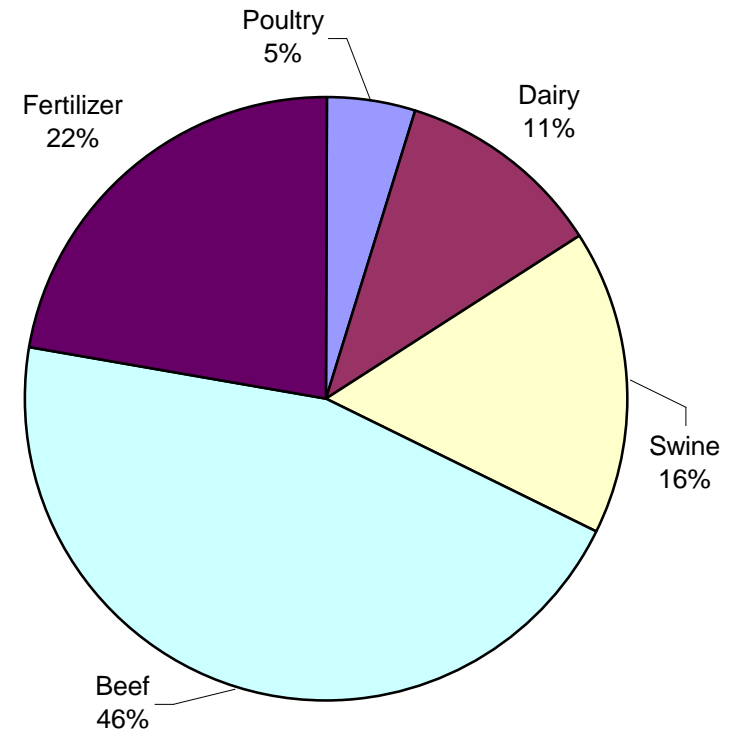
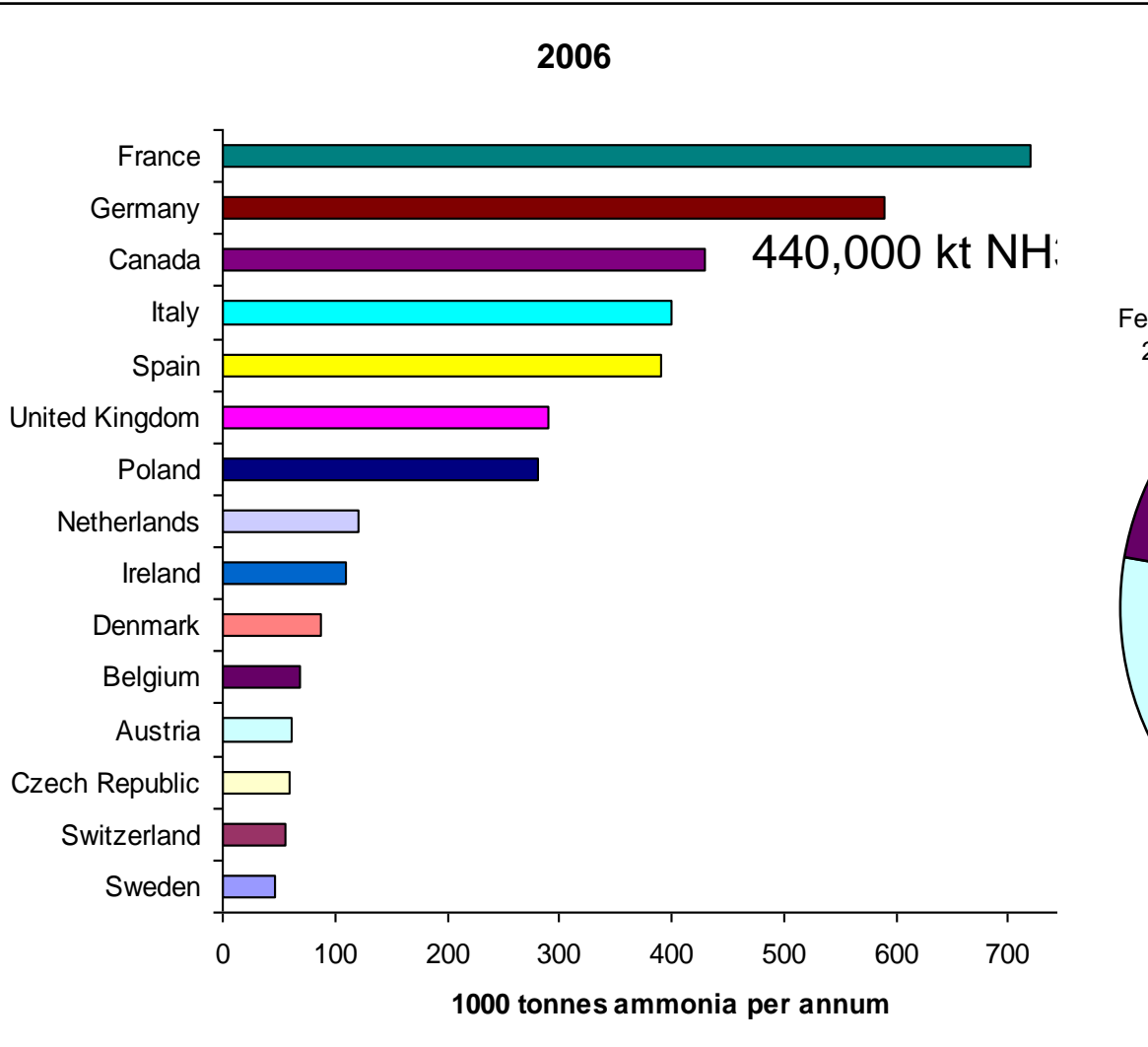
Nitrogen management in Canada - the current situation and recent developments

Shabtai Bittman

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Canada 

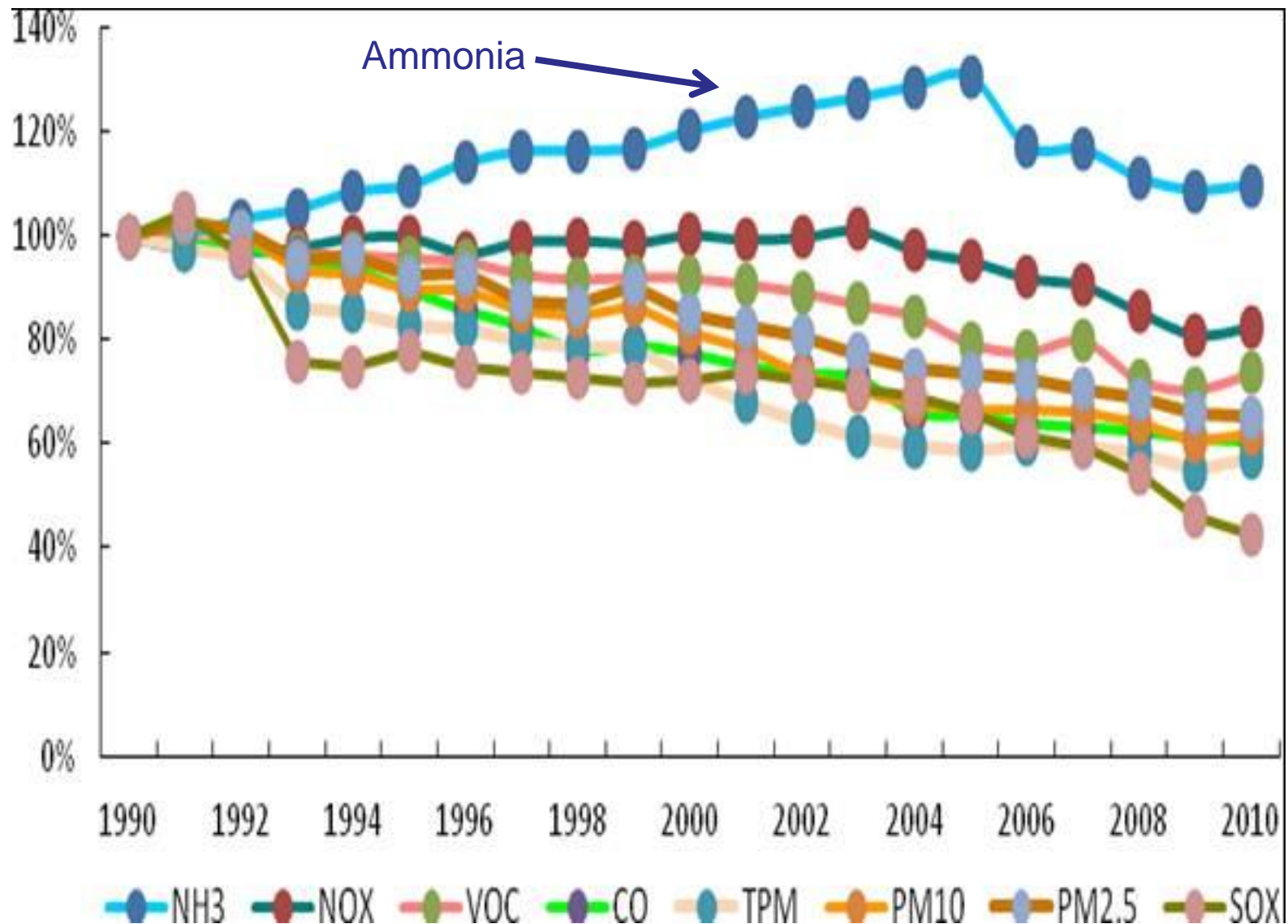
Ammonia emissions from agriculture in Canada- 2006



Agriculture contributes 85% of total NH₃ emissions

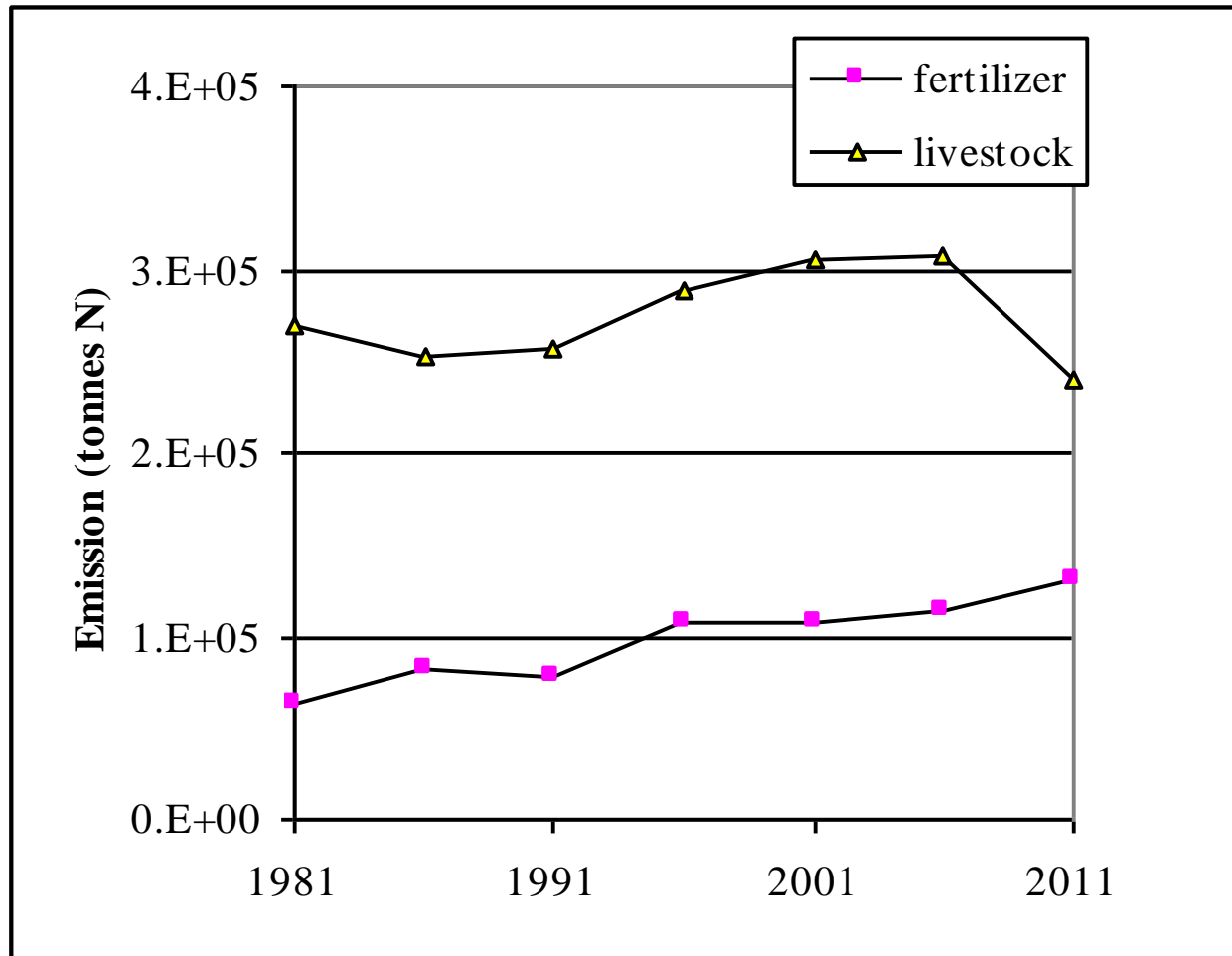
Agricultural emissions of ammonia

Prov.	Poultry	Beef	Dairy	Swine	Fertilizer	Provincial Share of National Emissions	
	Sector % contribution to 2006 NH3 emissions					2001	2006
BC	18.8	45.6	21.3	4.2	10.0	4.0	3.6
AB	1.8	70.0	4.4	7.9	20.0	27.9	27.3
SK	1.0	51.1	1.5	7.2	39.4	20.9	21.4
MB	3.2	44.0	4.2	22.0	26.0	10.7	11.4
ON	9.0	32.9	20.7	23.2	15.9	18.8	18.6
QC	7.4	18.5	27.7	35.4	12.9	14.7	14.8
NB	14.8	27.0	25.9	16.7	16.7	0.7	0.6
NS	19.7	30.0	27.4	14.8	8.4	0.8	0.7
PE	2.0	32.3	21.7	22.3	22.3	0.7	0.7
NF	16.9	11.2	61.5	2.3	7.7	0.1	0.1
	4.8	45.5	11.1	16.1	22.3	100	100
			Total National Emissions (tonnes NH3 /yr)			430000	440000

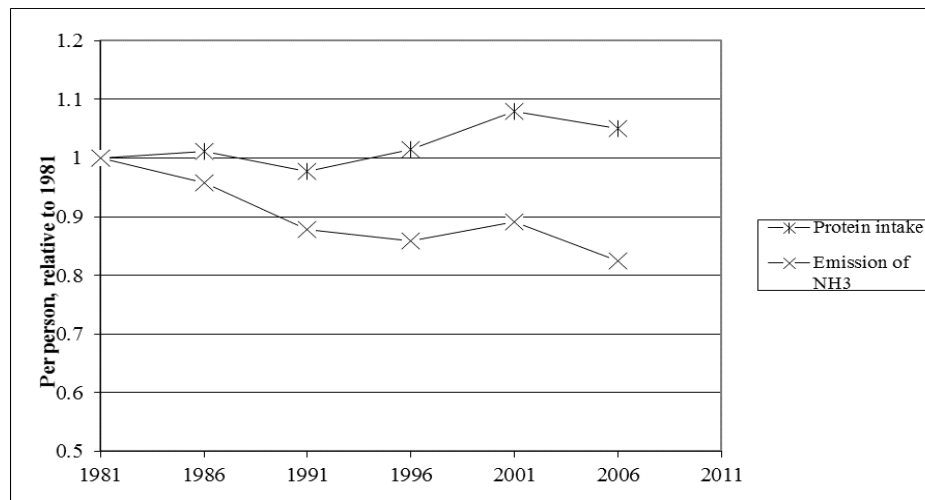
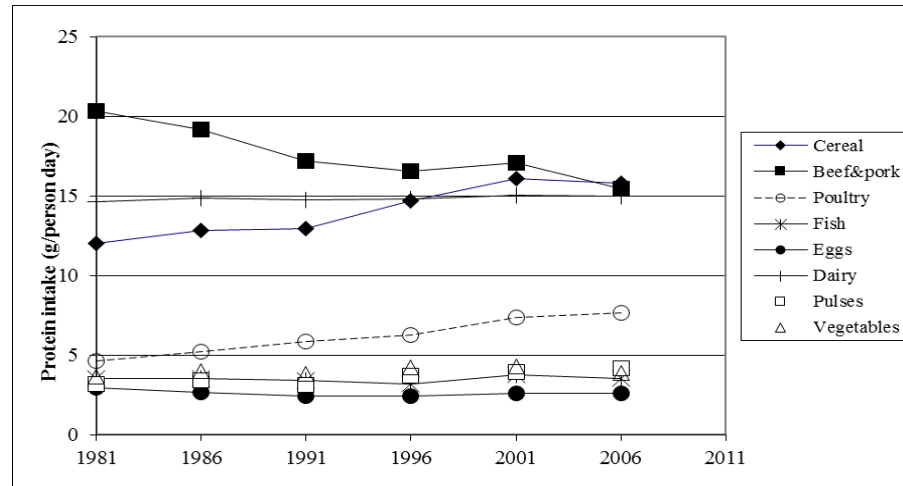


Trend in air emissions of predominant air pollutants over 20 years in Canada

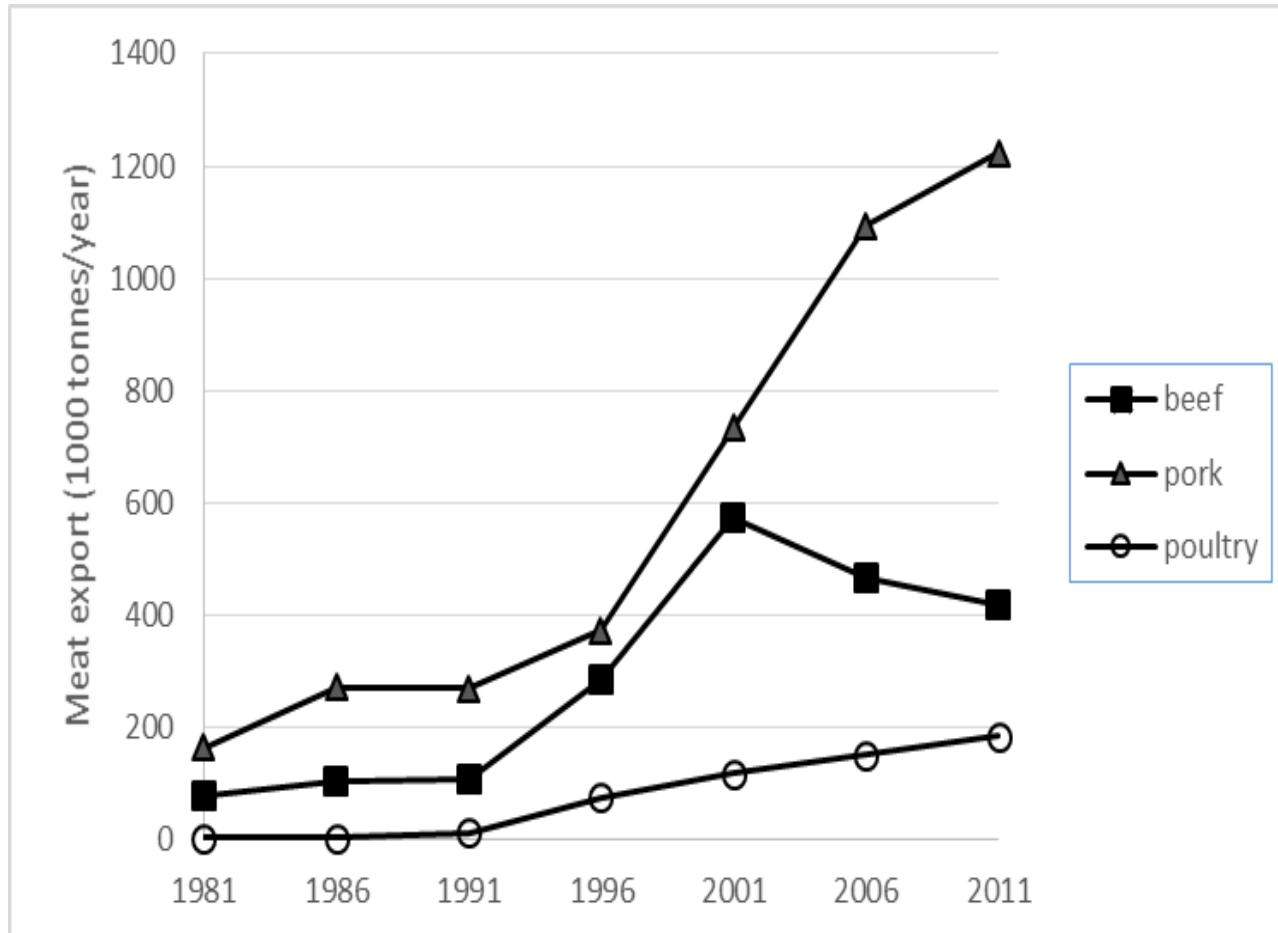
Change in emissions from fertilizer and livestock 1981-2011



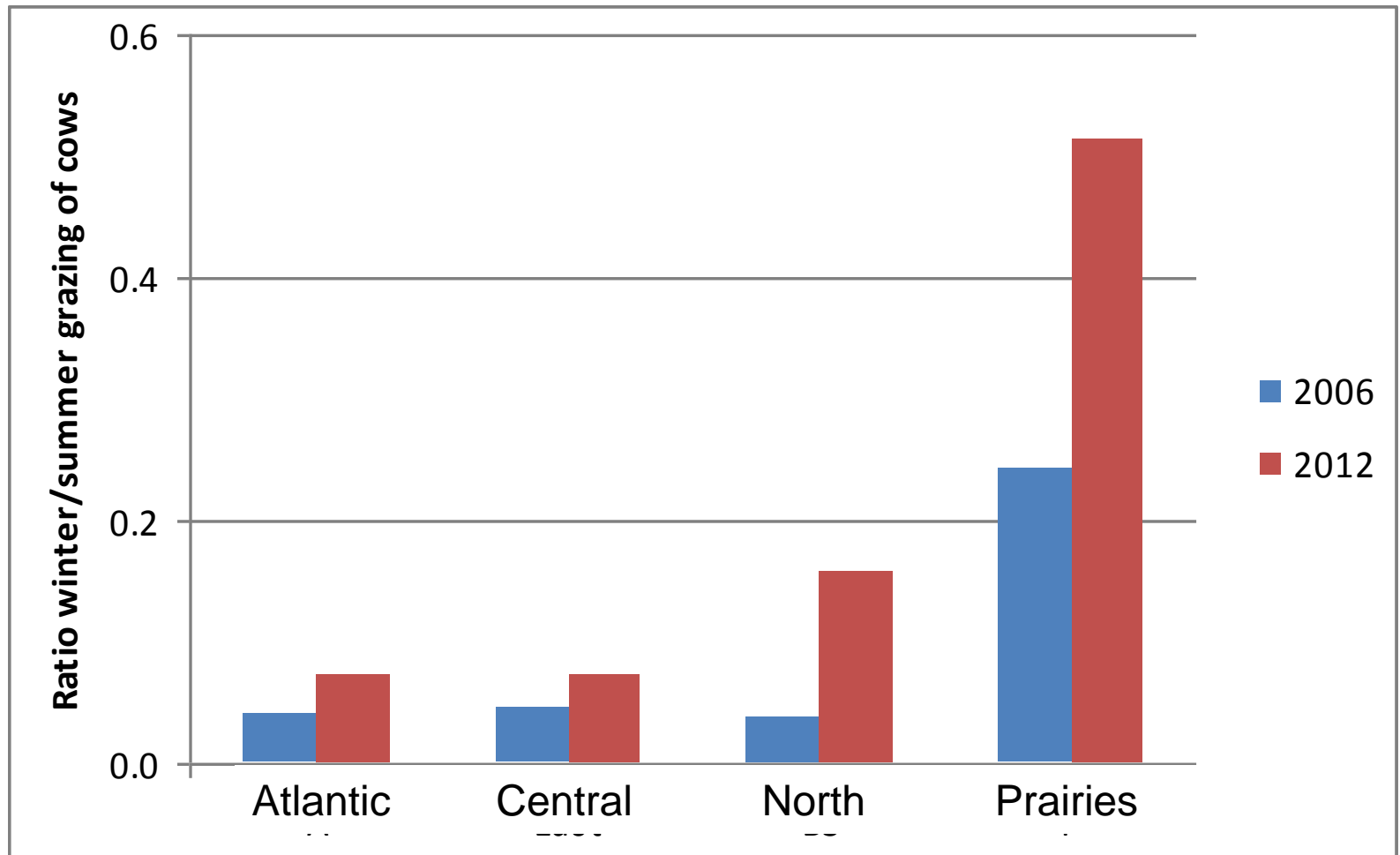
Change in food consumption and associated ammonia emissions in Canada (1981-2011)



Change in Canadian export of animal products 1981-2011



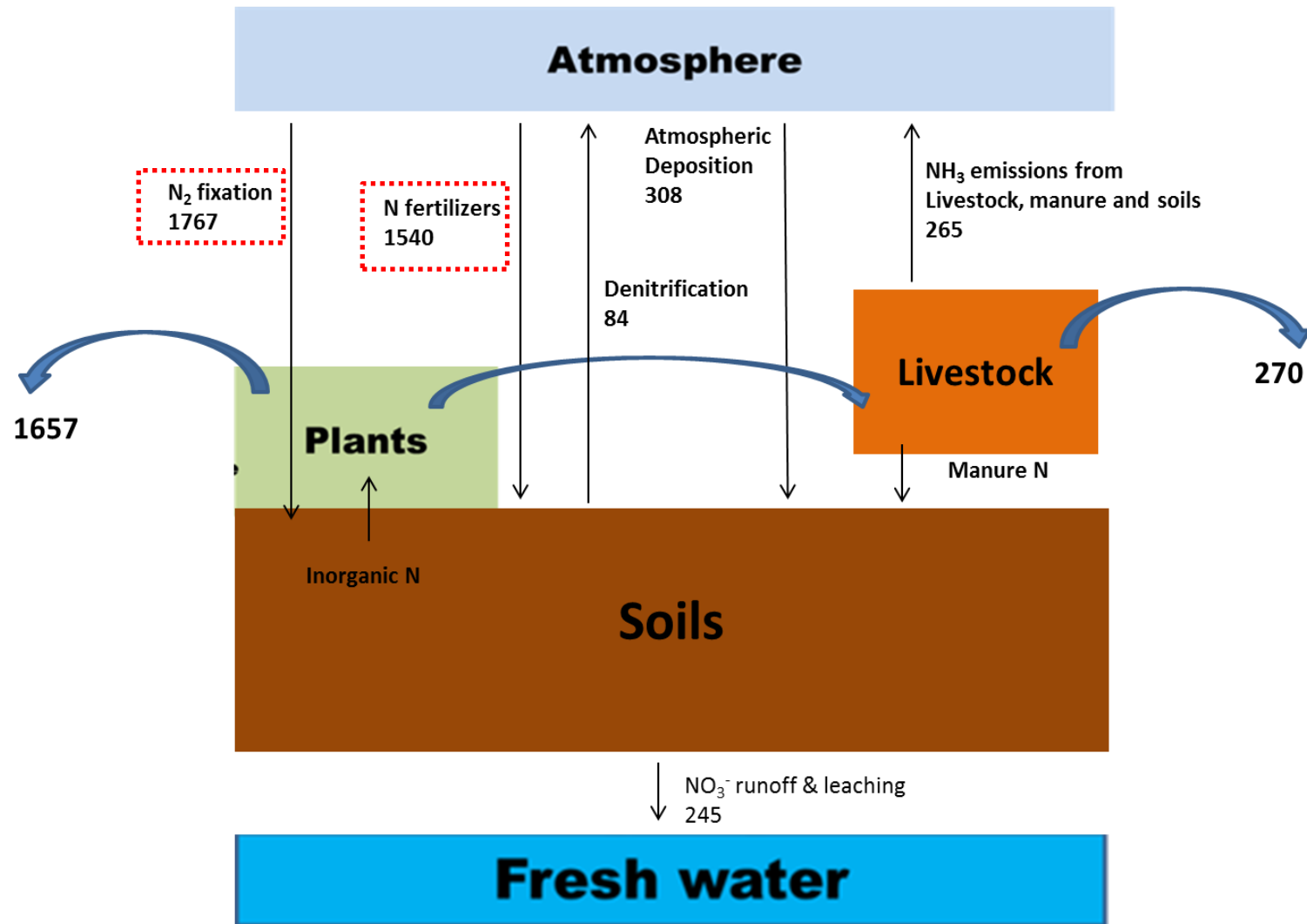
Increase in winter grazing by (pregnant) beef cows from 2006 to 2012







Agricultural Systems



Main components of the agricultural budget for N_r in Canada. Values in kt N/year (from Clair et al. 2014)

Legumes are important source of N in extensive pastureland



Search for persistent alfalfa
for western pastures



Current 'Ammonia Abatement Measures' in Canada

Measure

- Phase feeding (cost saving)
- Deep Injection and shallow injection (odour, runoff but worry about more leaching, more custom applicators)
- Manure incorporation (tillage systems, larger equipment)
- Fertilizer injection (cost saving)
- Grazing (cow-calf- low cost)
- Increased legumes (rotations)- reduce fertilizer

But

- Increase use of urea based fertilizer
- Increased no-till and perennial crops
- Dry Distillers Grains
- More loose housing for dairy

Fraction of farms (%) applying slurry manure by broadcast, bands on surface such as with a drop hose or sleigh-foot, shallow injection where some manure remains on the surface, or deep injection where little manure remains on the surface; the remainder is applied by some other method which includes irrigation, but this is <1%^a.

	Atlantic	On/ QC	Boreal	Prairie	Pacific	Canada
Dairy						
broadcast	82	82	83	70	85	80
surface bands	10	6	8	2	1	5
shallow injection	2	5	4	12	3	6
deep injection	0	3	0.0	14	0	4
Swine						
broadcast	76	65	56	45		59
surface bands	16	10	13	4		9
shallow injection	2	12	9	16		12
deep injection	1	9	17	31		16

Efficacy of low-cost BMPs in Canada, with costs based on UNECE (2012) (Sheppard and Bittman, in press)

Beef

Sector and stage	BMP details	Reduction/ sector (%)	Reduction Stage (%)	National NH ₃ saving (Gg N)	National cost per year
Grazing	Increase cows on pastures in winter from 40% to 60%, which may include swath or bale grazing	10	10	10	unknown, may be a cost saving
Feed	Decrease feed crude protein feed for all confined beef including finishers	8	---	5	±\$150M ^a
Solid landspreading	Present average 57% of solid manure goes to tilled land and it takes 14 to 60 hr to incorporate, change to 4 hrs to incorporate	8	30	20	unknown

Efficacy of low-cost BMPs in Canada, with costs based on UNECE (2012) (Sheppard and Bittman, in press)

Dairy

Sector and stage	BMP details	Reduction/ sector (%)	Reduction Stage (%)	National NH ₃ saving (Gg N)	National cost per year
Feed	Lactating and dry cow dietary crude protein lowered to UNECE 'ambitious' levels (from 17.0% to 15.5%) , likely with addition of specific amino acids	5	---	3	±\$200M ^a
Housing	Presently 30-39% herds are in tie stall barns , change all these to free-stall solid floor barns (this reflects the trend in the industry rather than an NH ₃ -related BMP)	-1	-7	-2	increases emissions
Slurry spreading	Presently 65% of dairy farms use slurry with 82% of this is broadcast , change to eliminate all broadcast by increasing surface banding (drop hose or sleigh foot), shallow injection and deep injection to about 33% each	10	30	8	\$5M
Solid spreading	Present average 67% of solid manure goes to tilled land and it takes 14 to 60 hr to incorporate, change to 4 hrs to incorporate	4	8	2	unknown

Conclusions potential for low cost NH₃ abatement in Canada

- Relatively low-cost BMPs related to slurry manure applied nationwide could save 16 Gg NH₃-N year⁻¹ for an estimated cost of \$13 M.
- Other low-cost BMPs could increase this to a saving of 79 Gg NH₃-N year⁻¹ or 26% of present emissions.

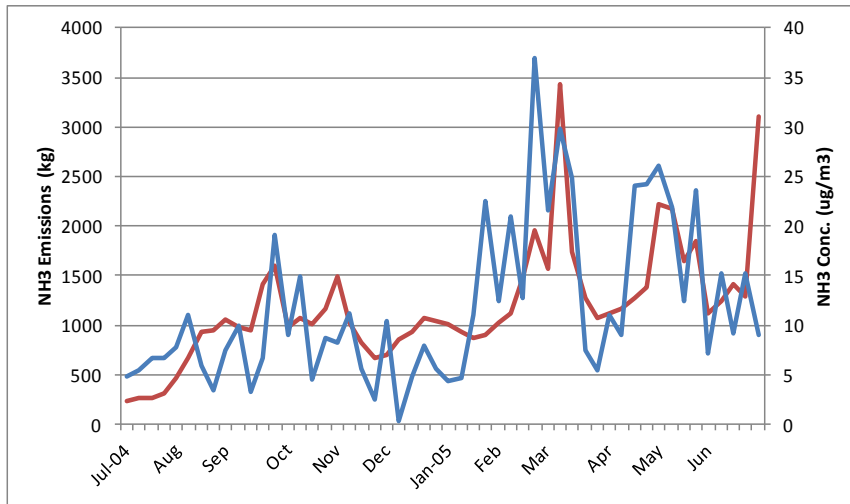
Ammonia affects air quality



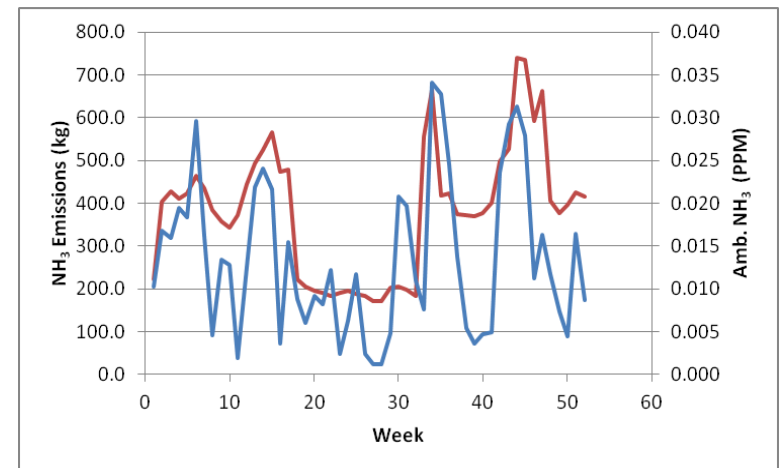
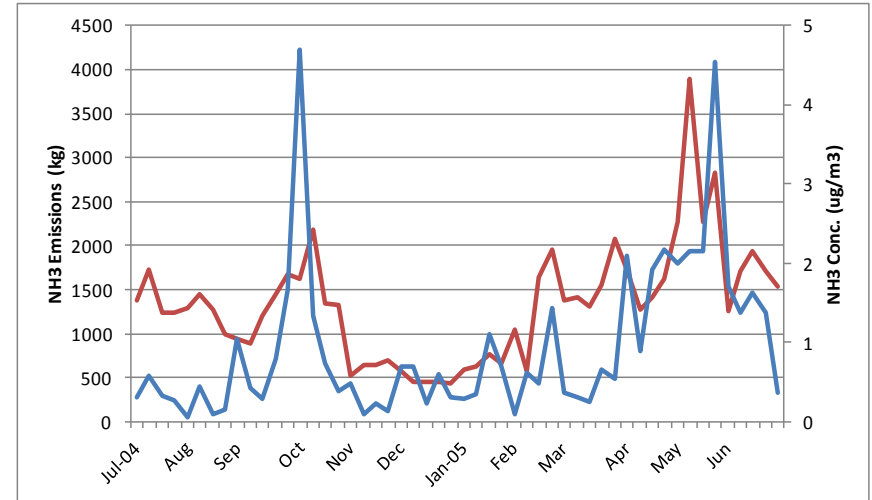
Gray haze due to fine particles made of ammonia for agriculture and nitrate from vehicles ---
reduces visibility and hurts tourism

Ammonia emissions (red) and ambient atmospheric concentrations (blue) in the LFV during poultry cull (2004-2005)

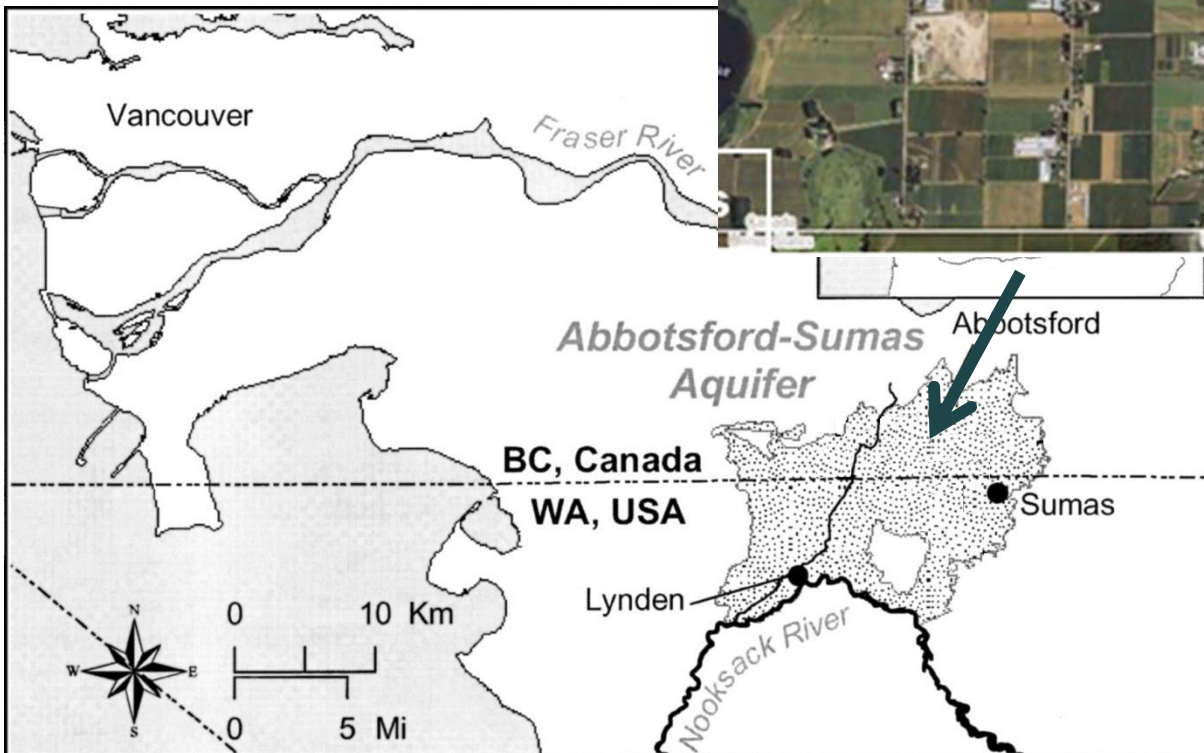
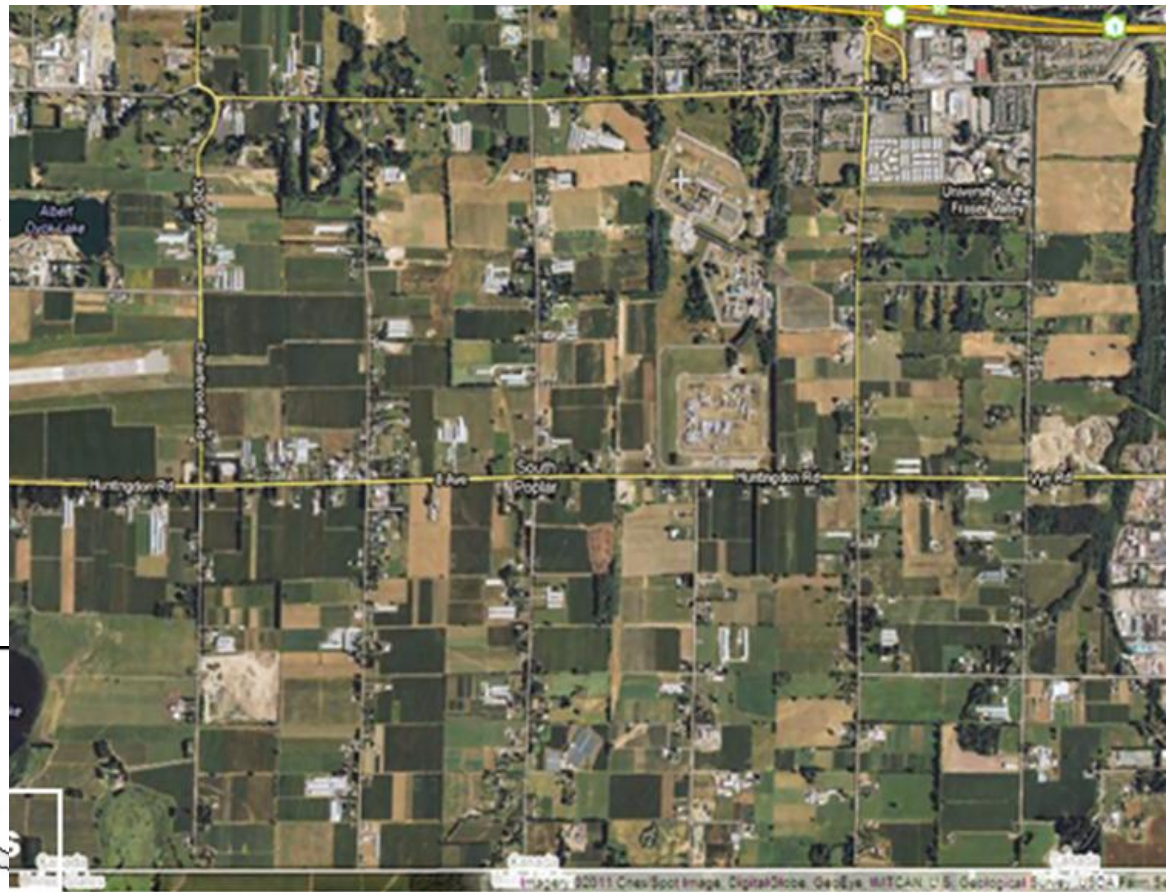
Poultry cull area



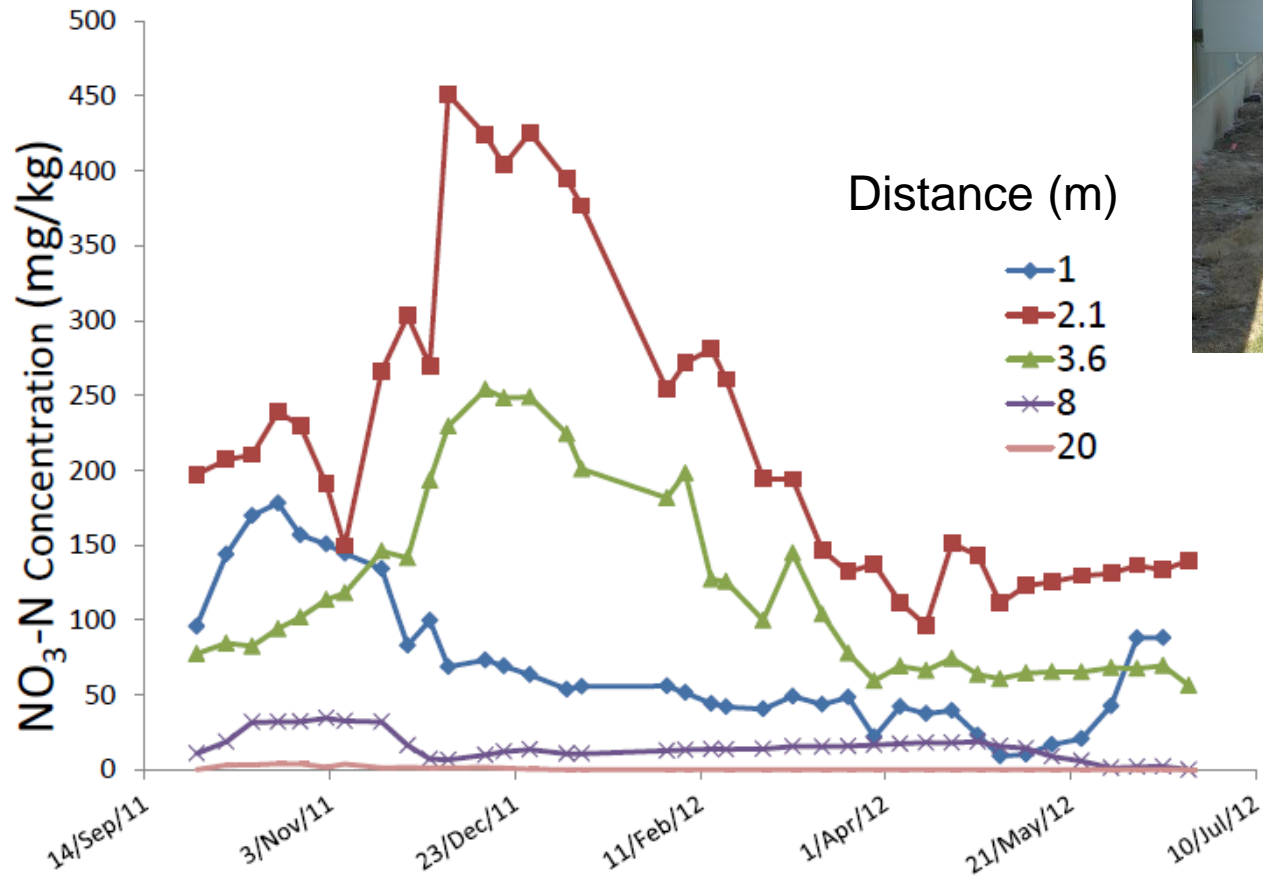
Non-cull area



Abbotsford Sumas Aquifer



Concentration of $\text{NO}_3\text{-N}$ in soil water at 45-cm depth at various distances outward from principal barn fans



Integrated 'NH₃' solutions

**Improving crop recovery of N and P from dairy slurry:
multi-year assessment of the 'dual manure steam' concept**

RAMIRAN Workshop

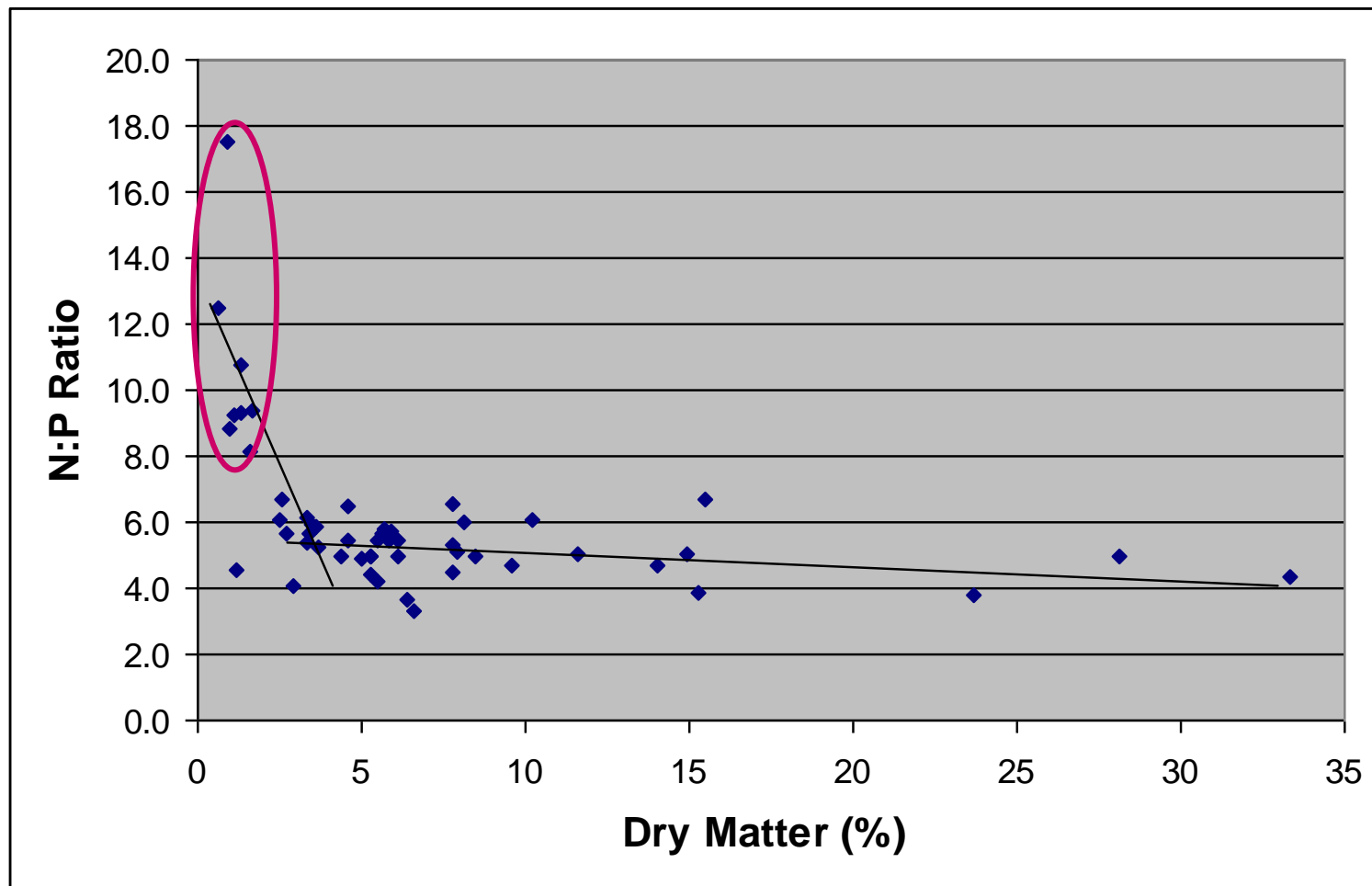
3-5 June 2013; Versailles, France

Shabtai Bittman*, Derek Hunt, and Grant Kowalenko

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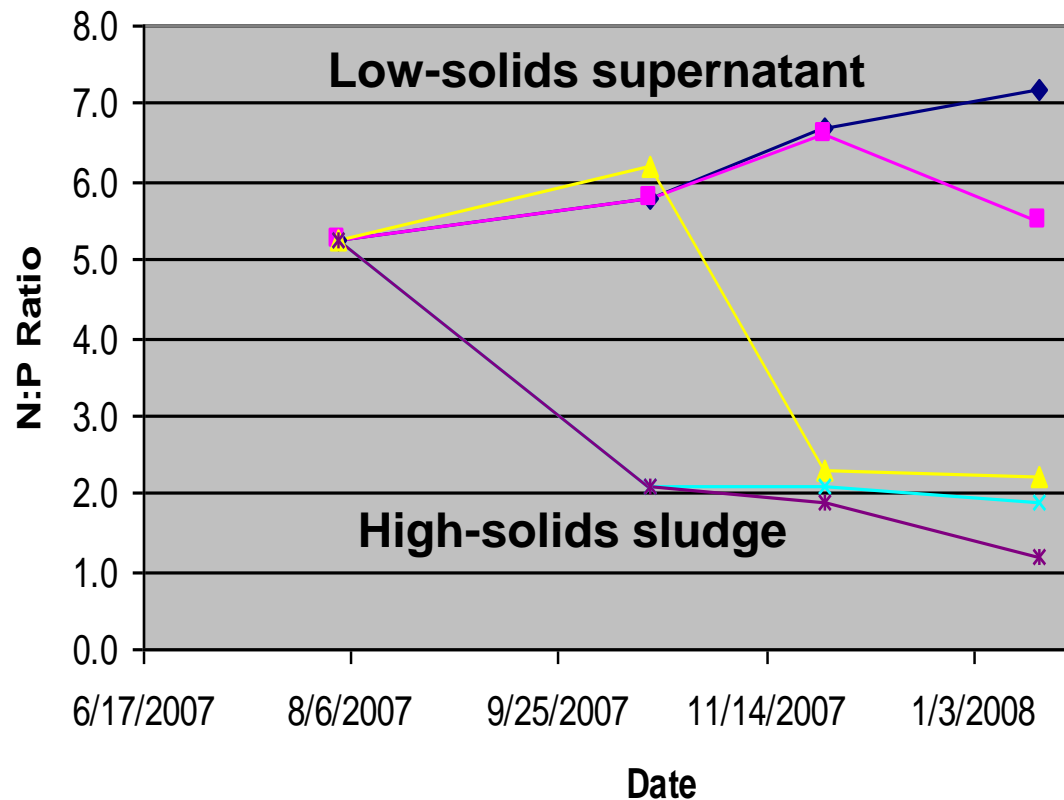
Relationship between N:P ratio and dry matter content in farm dairy manures

Fraser Valley, BC, Canada



Dual manure stream concept

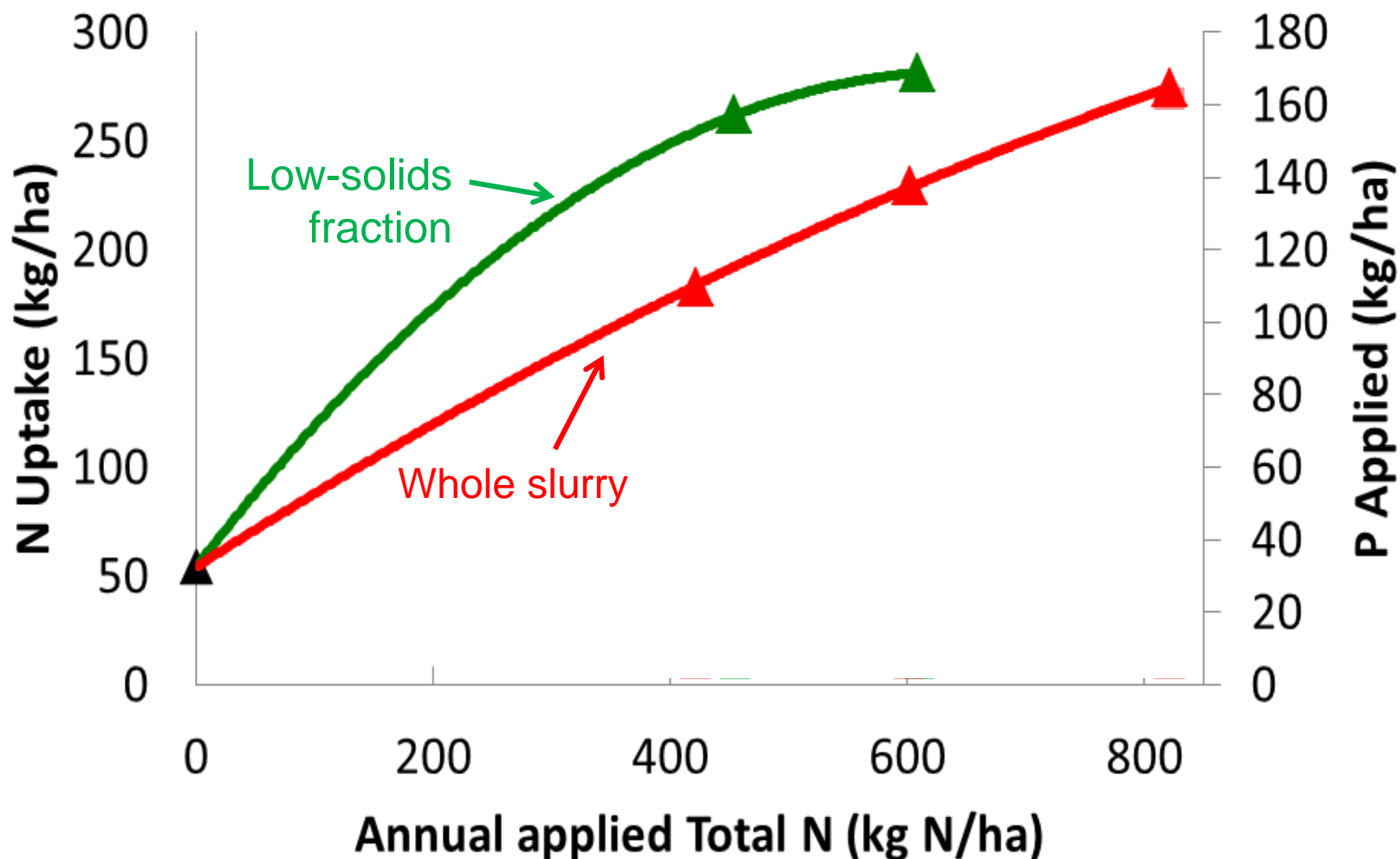
-2 products with contrasting N:P ratios



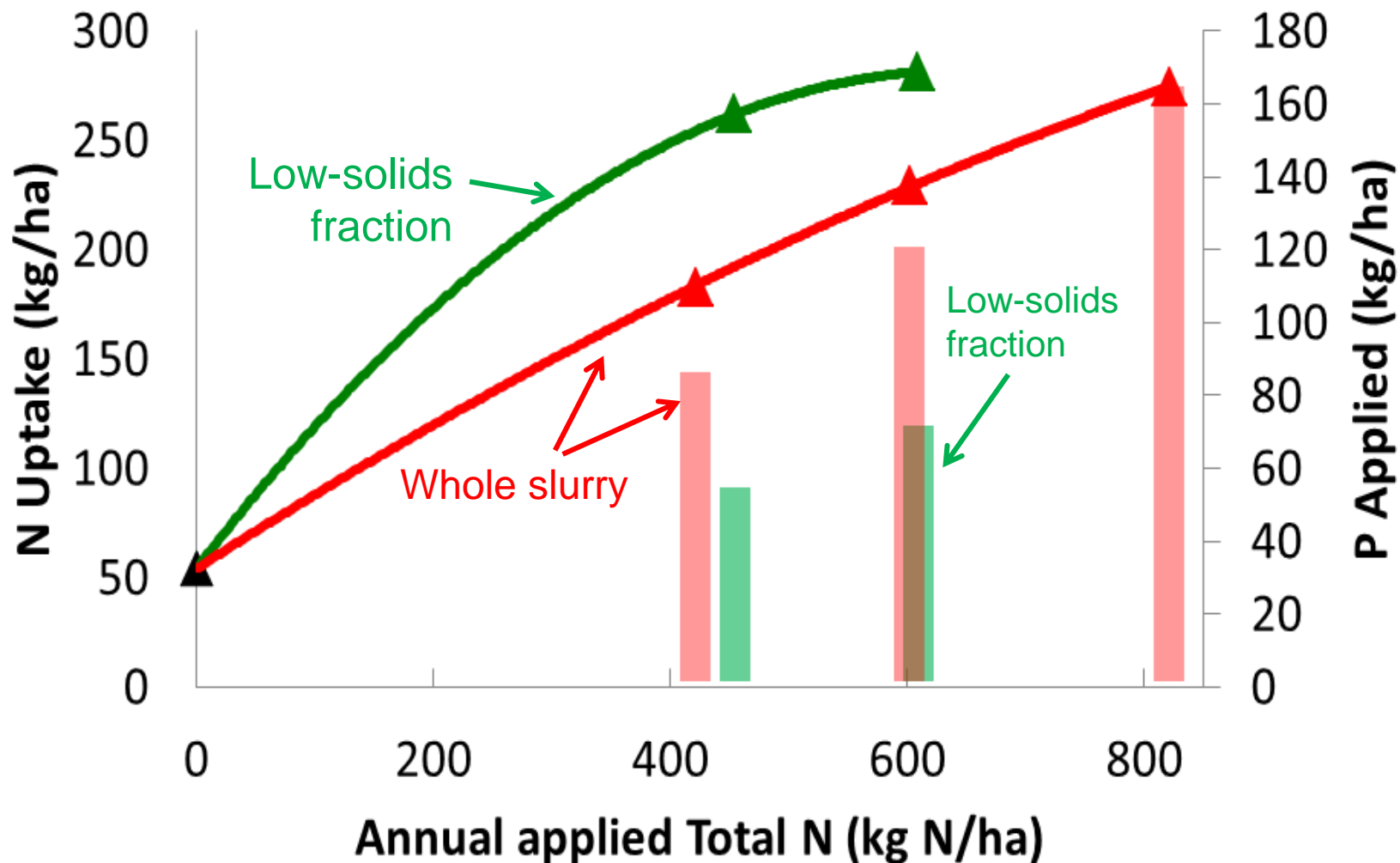
Managing the low-solids (liquid) fraction



Effect of whole slurry and low-solid separated fraction on grass N-uptake and on P loading (8 yr average)



Effect of whole slurry and low-solid separated fraction on grass N-uptake and on P loading (8 yr average)



N-use efficiency



Injecting sedimented high-solids fraction

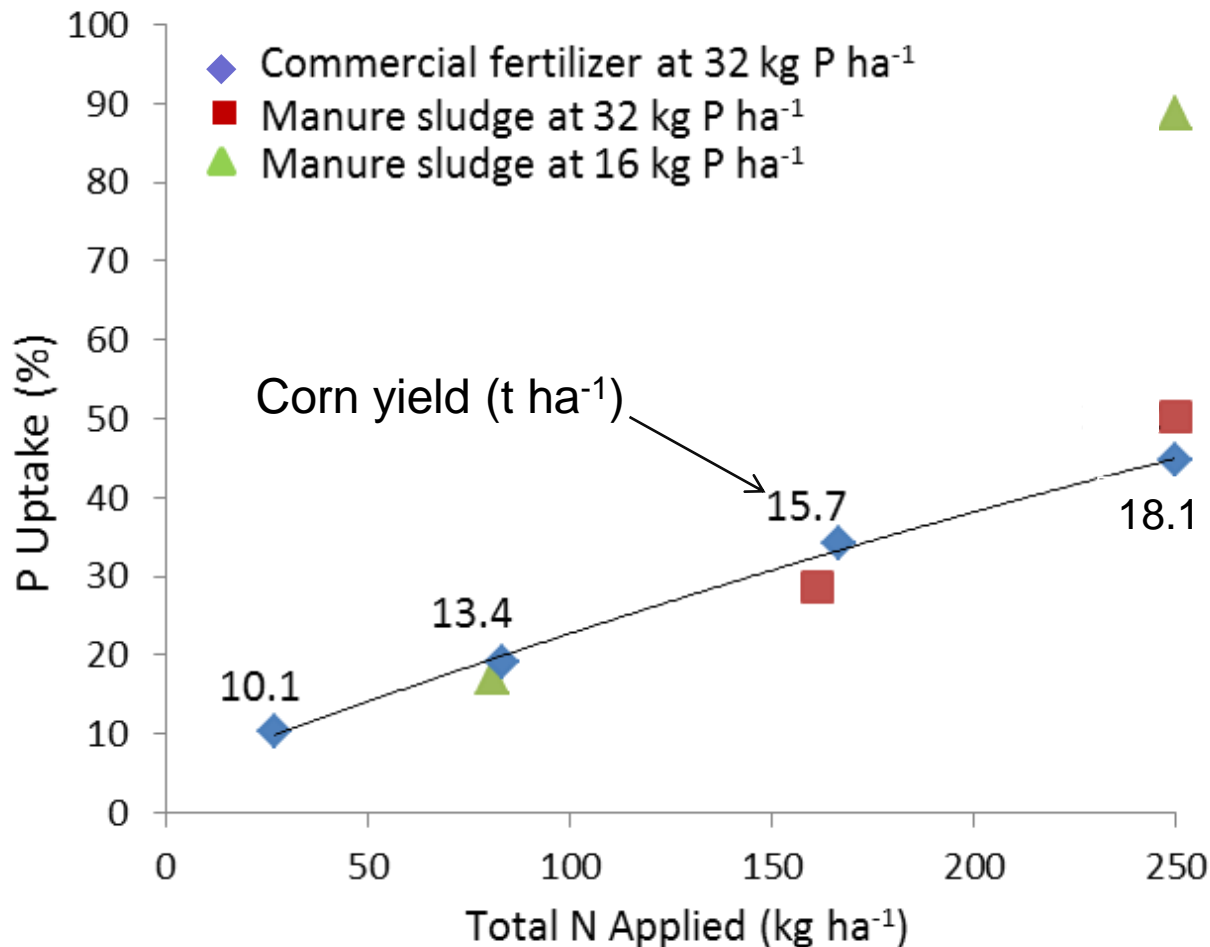
Sludge was injected at corn-row (75-cm) spacing to a depth of 15 cm, covered and left to soak for 5-7 days.



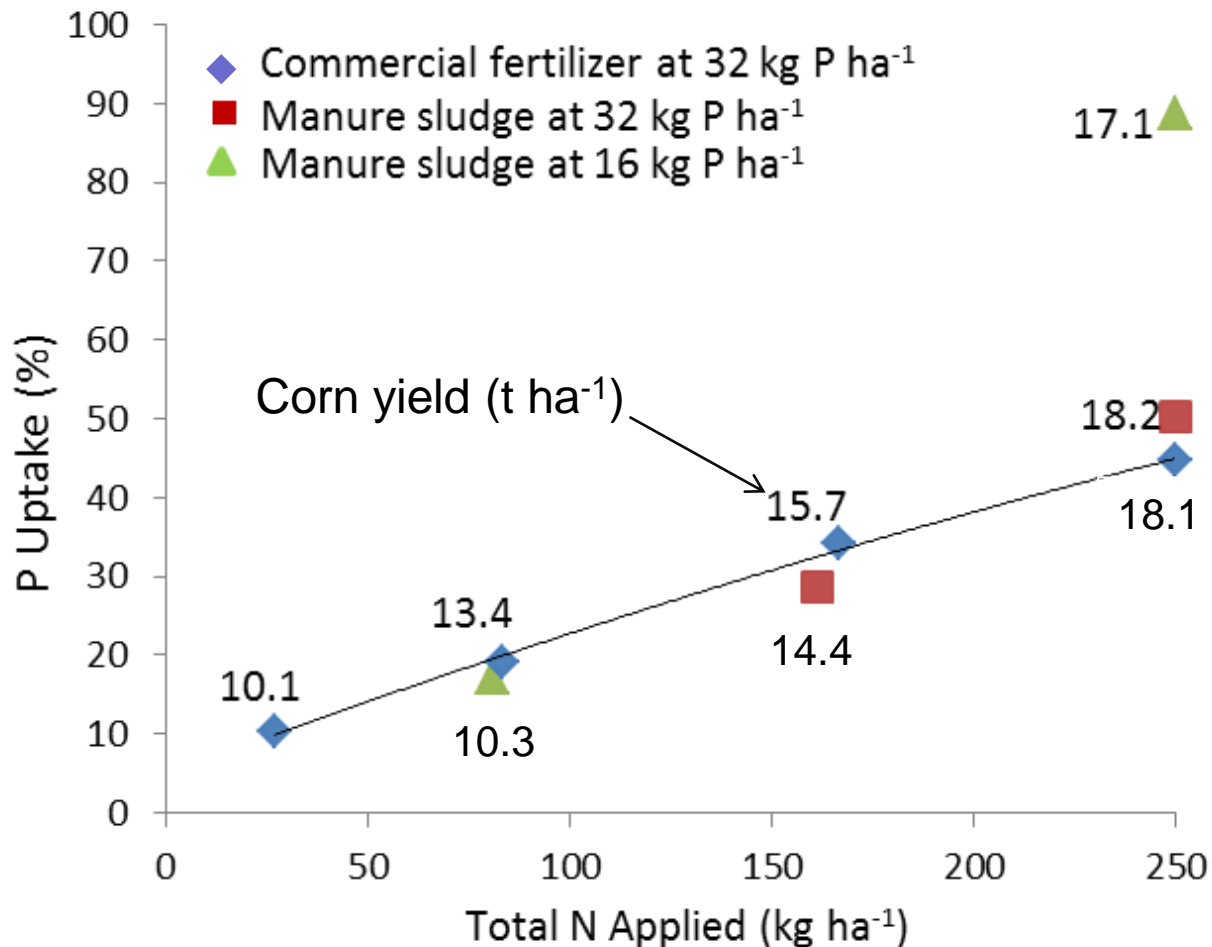
Corn was planted a few days later at (same) 75-cm spacing, 5-10 cm from the injection furrow.



Apparent P recovery and yield of corn receiving fertilizer and high-solids fraction at different N rates (2010-2012)



Apparent P recovery and yield of corn receiving fertilizer and high-solids fraction at different N rates (2010-2012)



Thank you



Concentration of $\text{NO}_3\text{-N}$ in soil water at 45-cm depth at various distances outward from principal barn fans

