Not only emission inventories: Using CLRTAP data for agricultural research

Rasmus Einarsson

rasmus.einarsson@chalmers.se

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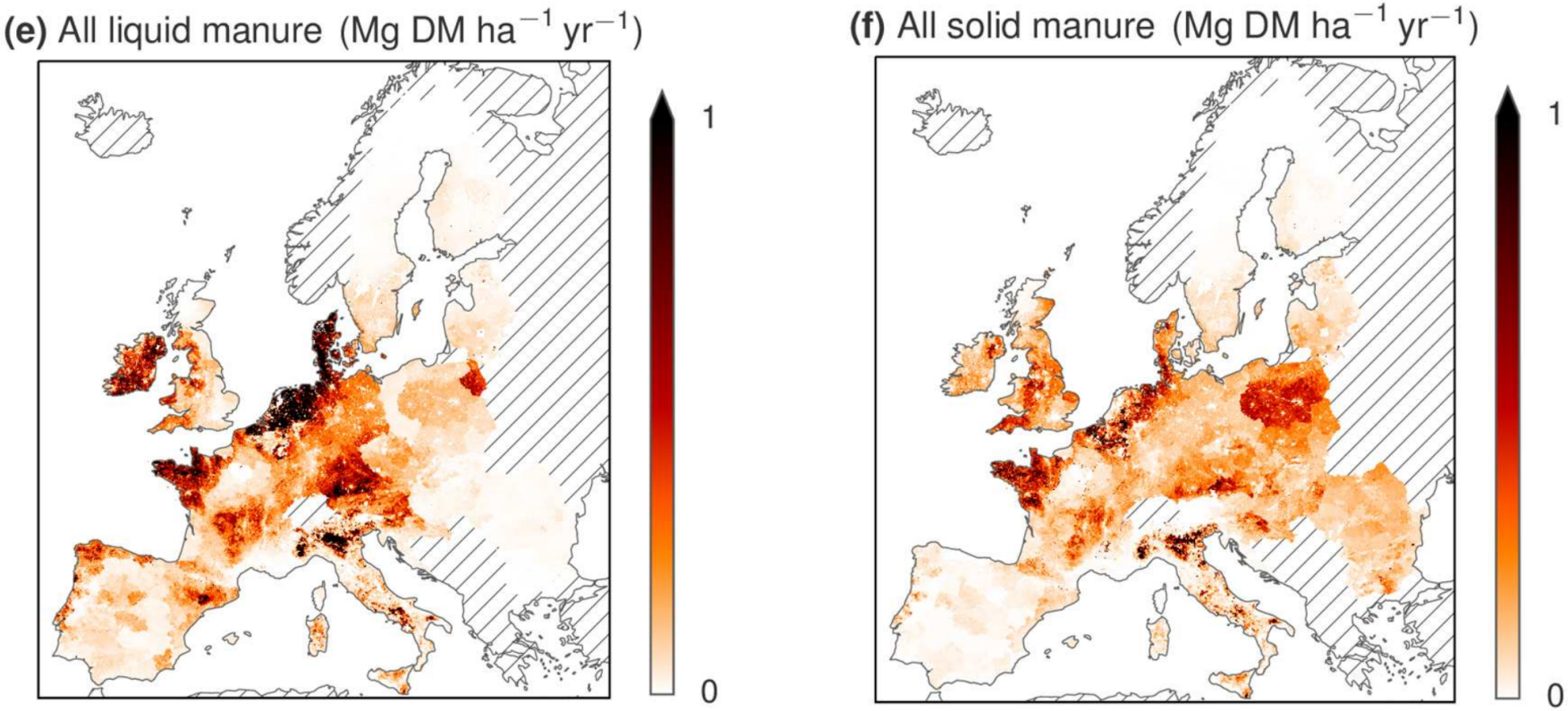
Who am I and what am I doing here?

- Postdoctoral researcher at Chalmers University of Technology, Sweden
- Broadly interested in food systems and environment
- PhD thesis "Agricultural nutrient budgets in Europe: data, methods, and indicators"
- Today: Want to highlight how we use national emission inventories to estimate manure N flows
- Happy to discuss further how national inventory data can be used more in research

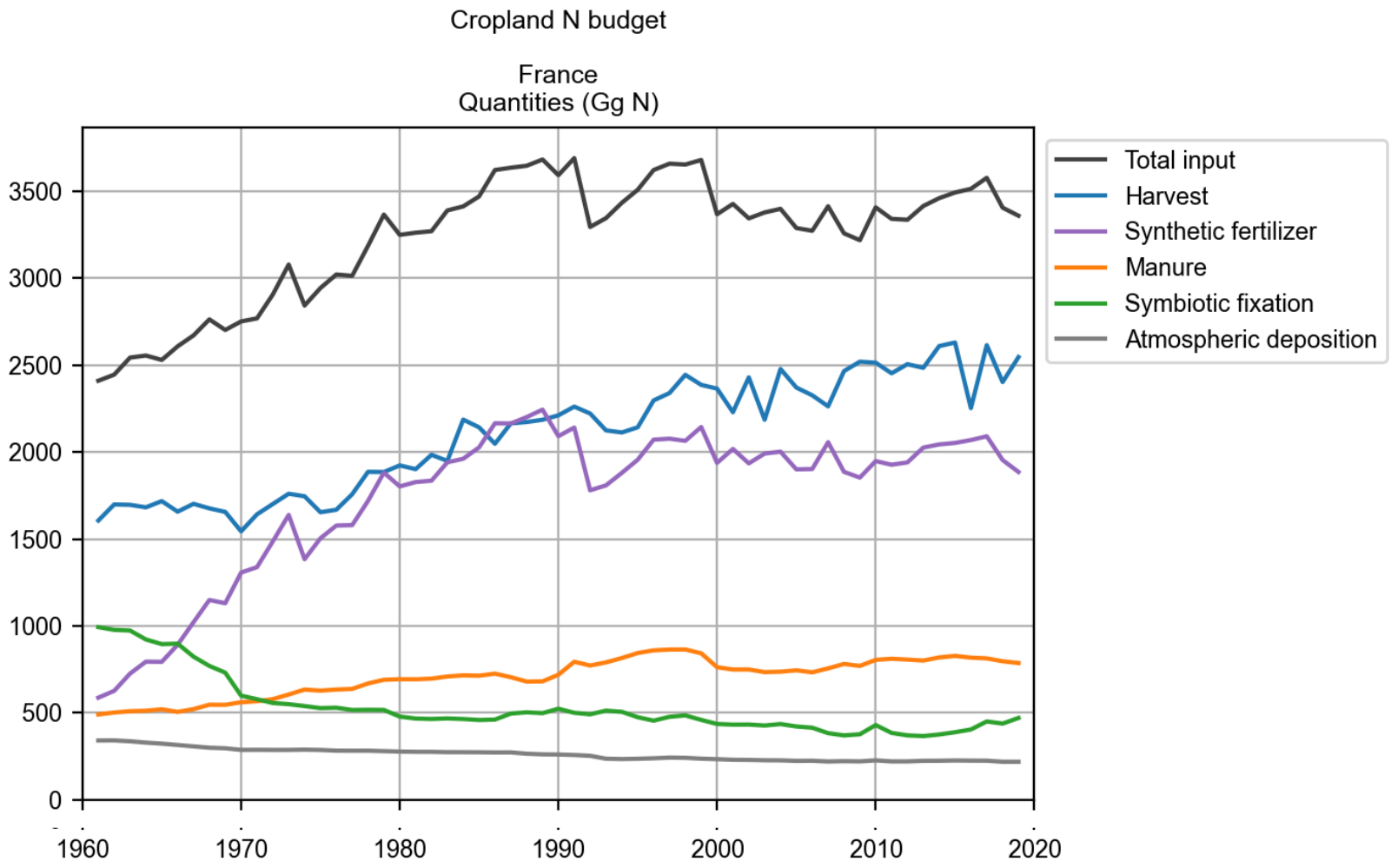
Einarsson (2020)

Example: The potential for biogas production from manure and crop residues in EU



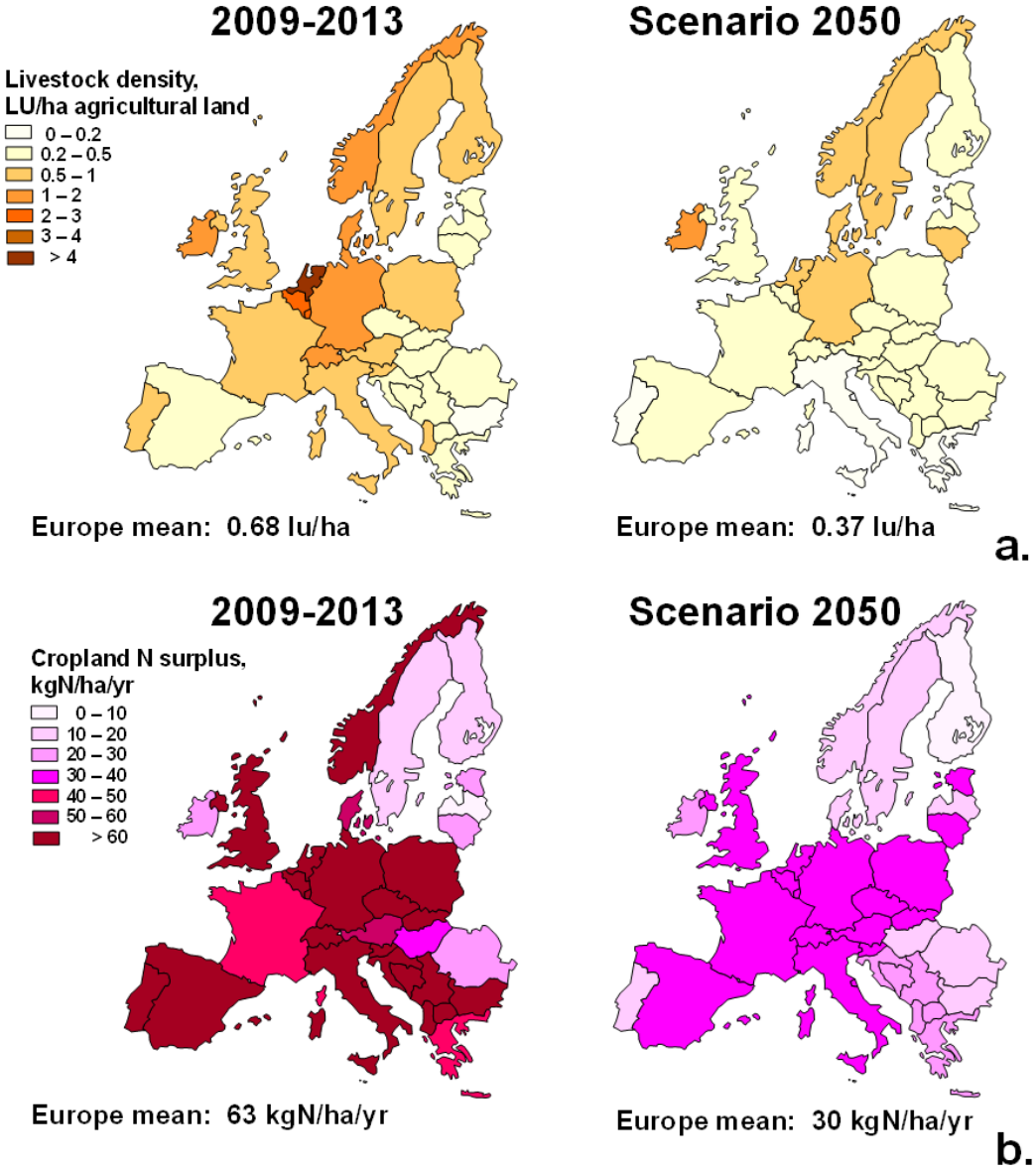
Einarsson and Persson (2017)

Example: N budgets in cropland 1961–2019



Einarsson et al. (in review), building on Lassaletta et al. (2014); see also Einarsson (2020)

Example: Scenarios for agriculture in Europe



Billen et al. (in review)

Limited details about manure flows in agricultural statistics

International statistics databases are rich in data on

- crop areas and production
- livestock populations and production

But how to estimate manure flows?

- excretion per head?
- manure management systems?
- N losses in storage and application?

— the best answer is usually found in CLRTAP reporting!

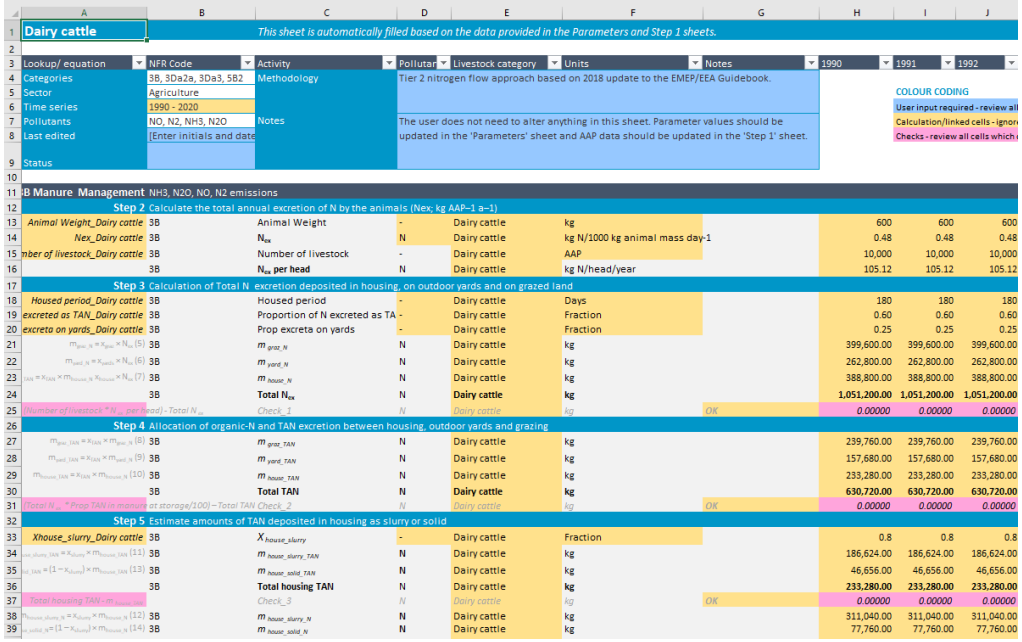
	UNFCCC		CLRTAP		Eurostat
	NIR*	CRF	IIR*	NFR	GNB
Machine readable		x		x	x
Total N excretion					x
N excretion by animal & MMS	(x)	x	x		
Manure N applied			x	x	
Detailed N emissions			x	x	
Lots more: Storage systems, application, explanations of trends in EFs, etc	(x)		x		

* NB. NIR and IIR contents vary; table indicates typical situation.

NIR = National Inventory Report; CRF = Common Reporting Format; IIR = Informative Inventory Report; NFR = Nomenclature For Reporting; GNB = Gross Nutrient Budget

More machine readable data in the future?

- IIRs are immensely useful to understand manure flows
- Machine-readable data formats facilitate reuse
- For example, EEA/EMEP Manure N Flow Tool would be a very useful format



	A	B	C	D	E	F	G	H	I	J
1	Dairy cattle	This sheet is automatically filled based on the data provided in the Parameters and Step 1 sheets.								
2										
3	Lookup/ equation	NFR Code	Activity	Pollutar	Livestock category	Units	Notes	1990	1991	1992
4	Categories	3B, 3Da2a, 3Da3, 5B2	Methodology	Tier 2 nitrogen flow approach based on 2018 update to the EMEP/EEA Guidebook.						
5	Sector	Agriculture								
6	Time series	1990 - 2020								
7	Pollutants	NO, N2, NH3, N2O	Notes	The user does not need to alter anything in this sheet. Parameter values should be						
8	Last edited	[Enter initials and date		updated in the 'Parameters' sheet and AAP data should be updated in the 'Step 1' sheet.						
9	Status									
10										
11	B Manure Management	NH3, N2O, NO, N2 emissions								
12	Step 2	Calculate the total annual excretion of N by the animals (Nex; kg AAP–1 a–1)								
13	Animal Weight_Dairy cattle	3B	Animal Weight	-	Dairy cattle	kg		600	600	600
14	Nex_Dairy cattle	3B	N_{ex}	N	Dairy cattle	kg N/1000 kg animal mass day-1		0.48	0.48	0.48
15	mber of livestock_Dairy cattle	3B	Number of livestock	-	Dairy cattle	AAP		10,000	10,000	10,000
16		3B	N_{ex} per head	N	Dairy cattle	kg N/head/year		105.12	105.12	105.12
17	Step 3	Calculation of Total N excretion deposited in housing, on outdoor yards and on grazed land								
18	Housed period_Dairy cattle	3B	Housed period	-	Dairy cattle	Days		180	180	180
19	excreted as TAN_Dairy cattle	3B	Proportion of N excreted as TA	-	Dairy cattle	Fraction		0.60	0.60	0.60
20	excreta on yards_Dairy cattle	3B	Prop excreta on yards	-	Dairy cattle	Fraction		0.25	0.25	0.25
21	$m_{graz\_N} = x_{graz} \times N_{ex}$ (5)	3B	m_{graz_N}	N	Dairy cattle	kg		399,600.00	399,600.00	399,600.00
22	$m_{yard\_N} = x_{yards} \times N_{ex}$ (6)	3B	m_{yard_N}	N	Dairy cattle	kg		262,800.00	262,800.00	262,800.00
23	$_{TAN} = x_{TAN} \times m_{house\_N}$ $x_{house} \times N_{ex}$ (7)	3B	m_{house_N}	N	Dairy cattle	kg		388,800.00	388,800.00	388,800.00
24		3B	Total N_{ex}	N	Dairy cattle	kg		1,051,200.00	1,051,200.00	1,051,200.00
25	(Number of livestock * N_{ex} per head) - Total N_{ex}		Check_1	N	Dairy cattle	kg	OK	0.00000	0.00000	0.00000
26	Step 4	Allocation of organic-N and TAN excretion between housing, outdoor yards and grazing								
27	$m_{graz\_TAN} = x_{TAN} \times m_{graz\_N}$ (8)	3B	m_{graz_TAN}	N	Dairy cattle	kg		239,760.00	239,760.00	239,760.00
28	$m_{yard\_TAN} = x_{TAN} \times m_{yard\_N}$ (9)	3B	m_{yard_TAN}	N	Dairy cattle	kg		157,680.00	157,680.00	157,680.00
29	$m_{house\_TAN} = x_{TAN} \times m_{house\_N}$ (10)	3B	m_{house_TAN}	N	Dairy cattle	kg		233,280.00	233,280.00	233,280.00
30		3B	Total TAN	N	Dairy cattle	kg		630,720.00	630,720.00	630,720.00
31	(Total N_{ex} * Prop TAN in manure at storage/100) – Total TAN		Check_2	N	Dairy cattle	kg	OK	0.00000	0.00000	0.00000
32	Step 5	Estimate amounts of TAN deposited in housing as slurry or solid								
33	Xhouse_slurry_Dairy cattle	3B	X_{house_slurry}	-	Dairy cattle	Fraction		0.8	0.8	0.8
34	$_{slurry\_TAN} = X_{slurry} \times m_{house\_TAN}$ (11)	3B	$m_{house\_slurry\_TAN}$	N	Dairy cattle	kg		186,624.00	186,624.00	186,624.00
35	$_{solid\_TAN} = (1 - X_{slurry}) \times m_{house\_TAN}$ (13)	3B	$m_{house\_solid\_TAN}$	N	Dairy cattle	kg		46,656.00	46,656.00	46,656.00
36		3B	Total housing TAN	N	Dairy cattle	kg		233,280.00	233,280.00	233,280.00
37	Total housing TAN - m_{house_tan}		Check_3	N	Dairy cattle	kg	OK	0.00000	0.00000	0.00000
38	$m_{house\_slurry\_N} = x_{slurry} \times m_{house\_N}$ (12)	3B	$m_{house\_slurry\_N}$	N	Dairy cattle	kg		311,040.00	311,040.00	311,040.00
39	$_{solid\_N} = (1 - x_{slurry}) \times m_{house\_N}$ (14)	3B	$m_{house\_solid\_N}$	N	Dairy cattle	kg		77,760.00	77,760.00	77,760.00

COLOUR CODING
User input required - review all
Calculation/linked cells - ignor
Checks - review all cells which

Thank you for your attention

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Einarsson, R. (2020). “Agricultural nutrient budgets in Europe: data, methods, and indicators”. PhD Thesis. Gothenburg, Sweden: Chalmers University of Technology. 203 pp. ISBN: 978-91-7905-367-3.

Einarsson, R. and U. M. Persson (2017). Analyzing key constraints to biogas production from crop residues and manure in the EU—A spatially explicit model. *PLOS ONE* **12** (1), e0171001. DOI: 10.1371/journal.pone.0171001.

Lassaletta, L., G. Billen, B. Grizzetti, J. Anglade, and J. Garnier (2014). 50 year trends in nitrogen use efficiency of world cropping systems: the relationship between yield and nitrogen input to cropland. *Environmental Research Letters* **9** (10), p. 105011. DOI: 10.1088/1748-9326/9/10/105011.