Tools to calculate manure quantity and quality and to plan regional manure nutrient recycling

Sari Luostarinen, Luke Principle Research Scientist, PhD, Adj. Prof.

Juha Grönroos, Finnish Environment Institute SYKE Eila Turtola & Risto Uusitalo, Luke



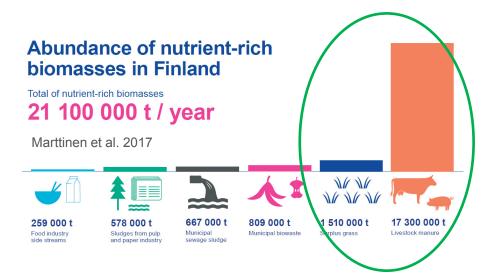




© Natural Resources Institute Finland

Finland aims to be a model country in nutrient recycling

- Need to close nutrient cycles to be less dependent on mineral fertilisers and to reduce emissions
- Agriculture in a key role
 - Biggest user and producer of nutrients











ESPC3, Helsinki, Finland

Challenges to be addressed

- Dense animal production in certain regions, while little animal production on others
 - Concentration of manure nutrients and challenges to use them
- Inefficient nutrient recycling from organic wastes
- History of too high fertilising recommendations
 - Increased P-content in field soils







Tools needed to ease solving the challenges

- Nutrient recycling is a vast topic
- Understanding it requires a lot of data
 - Recyclable biomasses: quantity, type and location
 - Current biomass management and future possibilities
 - End-uses especially in agriculture
 - Crop production, field soils, fertilising, yields and emissions currently and in future scenarios
- Difficult to put things together without assisting tools





SYKE

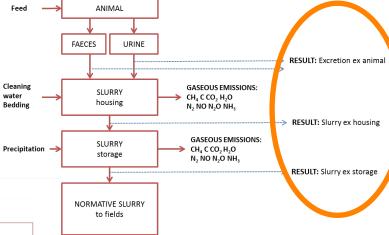
ESPC3, Helsinki, Finland

11.6.2018 © Natural Resources Institute Finland



Finnish Normative Manure System

• A mass balance model calculating the quantity and quality of manure under Finnish production conditions for 74 animal categories



Dairy cow (milk yield 8463 kg, live weight 640 kg)

MANURE LEFT ON PASTURE AND DRY LOT EXCLUDED

Excretion of Dairy cow (kg/ap/a)												
Category	Faeces	Urine	Ntot	Ptot	Ktot	DM _{faeces}	DMurine	OM _{faeces}	OMurine			
Dairy cow	12829.81	8394.20	135.54	23.87	126.43	1833.71	377.27	1588.98	113.21			

	Manure ex	ho	using of Da	iry cow						-					
		1.	otal nanure	Kg/ap/a						Kg per to	n of manı	ire			
Category	Manure type		/ap/a	Ntot	Nsol	Ptot	Ktot	DM	VS	Ntot	Nsol	Ptot	Ktot	DM	VS
Dairy cow	Slurry		19.21	99.68	55.83	19.12	101.41	1822.76	1410.36	5.19	2.91	1.00	5.28	94.89	73.42
	FYM		21.30	121.37	58.38	21.26	161.61	5872.57	5055.18	5.70	2.74	1.00	7.59	275.74	237.36
	Deep litter		16.45	106.11	17.17	21.26	161.61	5285.31	4467.93	6.45	1.04	1.29	9.82	321.29	271.60
	Dung		11.84	57.28	13.85	17.73	43.10	1856.74	1582.80	4.84	1.17	1.50	3.64	156.78	133.65
	Urine		7.88	48.49	46.31	1.54	61.49	305.71	133.28	6.15	5.87	0.19	7.80	38.78	16.91

	Manure ex :	storage of Dai	ry cow											
		Total												
		manure	Kg/ap/a						Kg per to	n of manu	ire			
	Manure													
Category	type	tn/ap/a	Ntot	Nsol	Ptot	Ktot	DM	VS	Ntot	Nsol	Ptot	Ktot	DM	VS
Dairy cow	Slurry	21.83	98.65	54.65	21.02	103.78	1778.02	1345.22	4.52	2.50	0.96	4.75	81.45	61.62
	FYM	24.61	107.89	17.00	23.16	163.98	5422.84	4585.06	4.38	0.69	0.94	6.66	220.34	186.30
	Deep litter	17.44	108.87	15.39	23.16	163.98	4894.31	4056.53	6.24	0.88	1.33	9.40	280.57	232.55
	Dung	14.29	57.43	3.93	19.63	45.47	1808.60	1514.26	4.02	0.27	1.37	3.18	126.52	105.93
	Urine	9.14	44.08	41.90	1.54	61.49	305.71	133.28	4.82	4.59	0.17	6.73	33.46	14.59



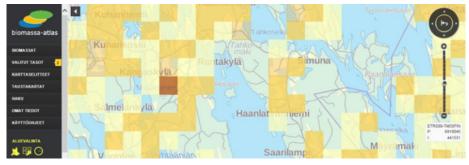


Uses of Normative Manure in nutrient recycling

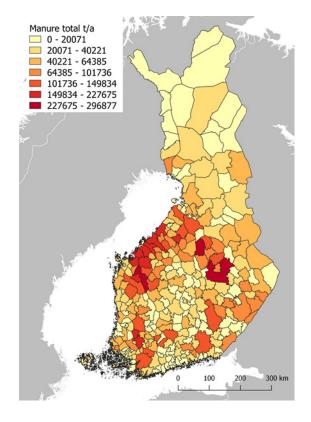
- Total manure quantities and nutrient contents
- Manure spatial distribution when coupled with animal numbers and farm locations
 - For planning future actions in animal production and manure processing
- Data on manure quantity available in a separate tool to map Finnish biomasses:

Biomass atlas

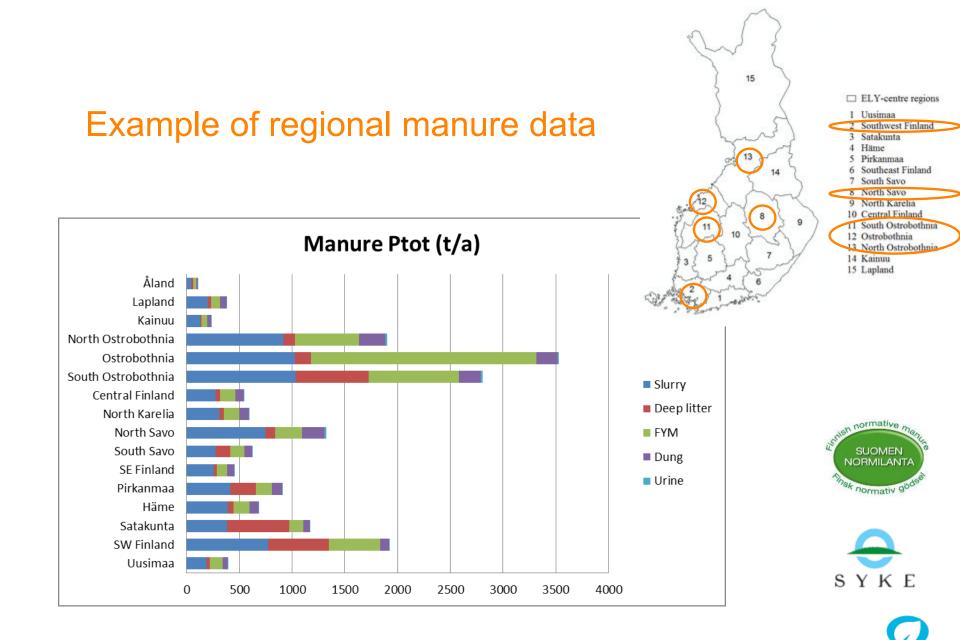
https://www.luke.fi/biomassa-atlas/en/





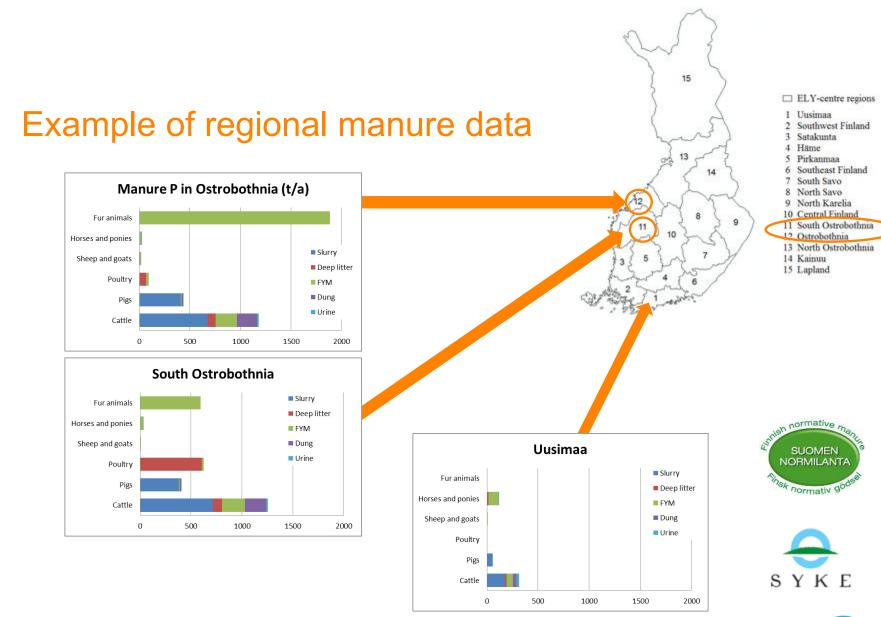








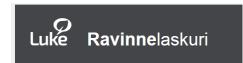
NATURAL RESOURCES INSTITUTE FINLAND





Nutrient calculator for planning regional nutrient recycling – **biomasses and processing**

- Includes recyclable biomasses
 - Manure, straw, unused grass
 - Sewage slugde, municipal biowaste
 - Other organic wastes and byproducts
- Calculates current management and share directed to different end-uses as a default
- User can make own scenarios for processing and end-uses and compare the change









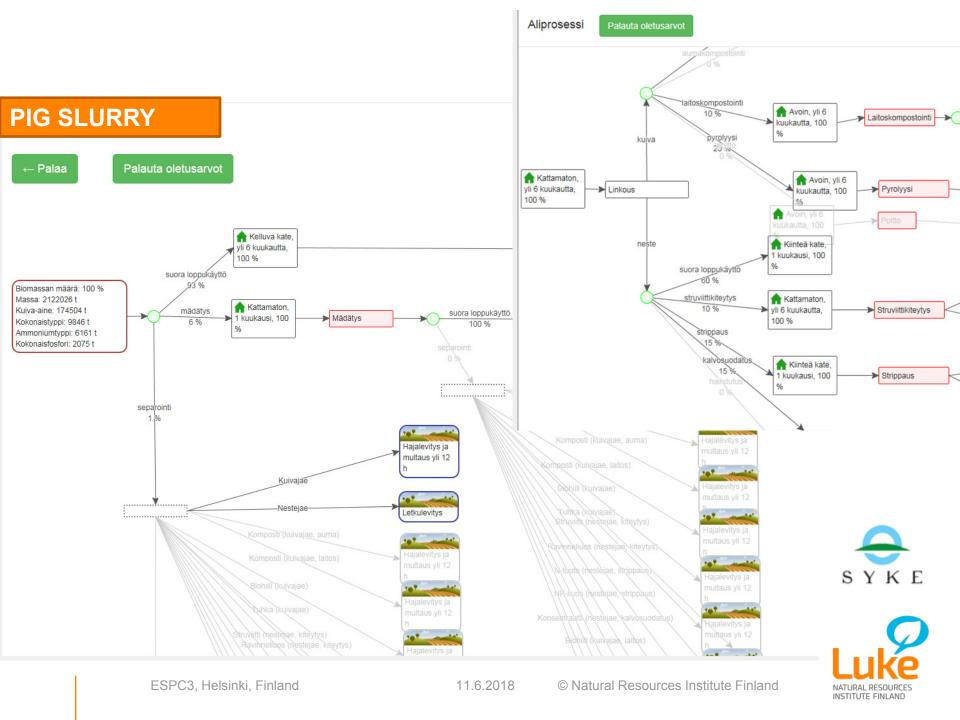
Nutrient calculator for planning regional nutrient recycling – **fertilising with recycled nutrients**

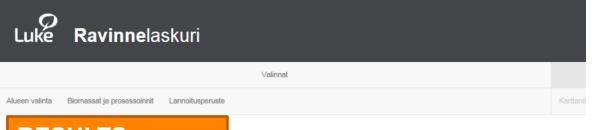
- Applies fertilisers on agricultural soils according to their type, Pcontent and crops produced
 - Three fertilising options: according to
 - Maximum of Finnish agrienvironmental scheme (N, P)
 - Crop need (P)
 - Nitrates directive (N)
- Estimates subsequent long-term changes in soil P and in soluble P loading potential





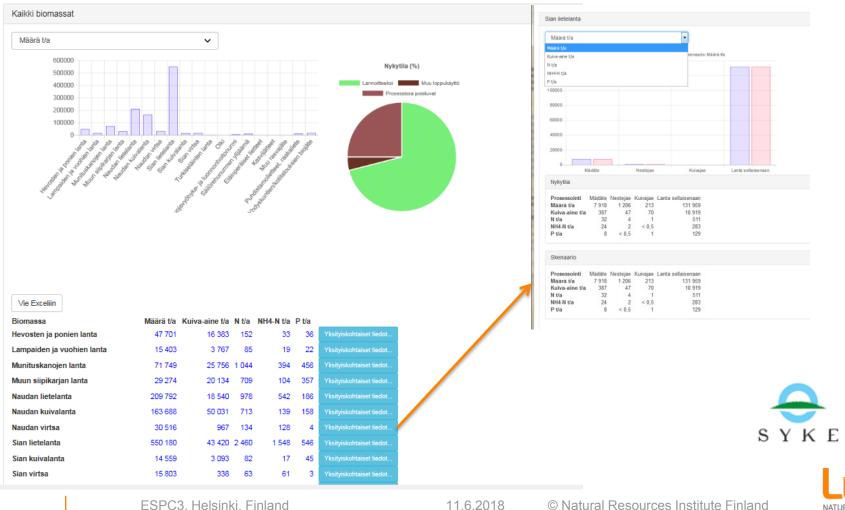
SYKE





RESULTS

Tuloksissa on huomioitu prosessoinnissa ja peltoon levitettäessä häviävät tai muuttuvat ravinnepitoisuudet.



NATURAL RESOURCES INSTITUTE FINLAND

	Ravinnela Biomassat ja prosessoinnit MASS NU Fosfori	Valinnat Lannoitusperuste		N FERTILI	Karttanákymá SING				15 15 15 16 13 13 13 13 13 13 13 13 15 15 15 15 15 15 15 15 15 15	- And	 ELY-centre regions Uusimaa Southwest Finland Southeast Finland
Fosfori	kg ation accordi 60 042 5 28 101 6 21 483 11 341 709 15	Kg) Yli-/alijäämi S5 799 88 136 88 12 98 790 -	p need	(P) Different municipalit		Surpl Nutrie -268 500 -268 400 -142 800 -47 270 - 1 -12 9803 -3 001 - 6 3 6 316 - 16 9 16 920 - 45	1855 isation 1 lus/deficiency ents in yield -142 900 -47 280 12 990 9 002 115 910 18 10		Aynamasi Poytya Nousianan Rusko Karya Raisey Turku Karya Raisey Turku Karya Raisey Turku Karya Raisey Turku	Lomia Kost T Kare	
350 000 300 000 250 000 200 000 150 000 50 000 0 −50 000 −100 000 −150 000			bhmaa Se	SURPLUS/DEFICI		45 820 - 87 SURPLUS DEFICIEN	S/ ICY	Resources Institu	SYKE		0 5 10 20 Km

ESPC3, Helsinki, Finland

NATURAL RESOURCES INSTITUTE FINLAND

How to really become a model country for nutrient recycling?

- Huge systemic change requires long-term work and cooperation
 - Clear playing field for all involved
 - The targets, actions and support systems must extend over national governmental or EU programme periods
 - The tools for planning, monitoring and thus supporting the change need to be maintained and used
 - Research and development still needed
- Much focus on technological processing: are there other things to be done, too?
 - Are large units and processing the most efficient way forward or could we use more decentralised solutions?







Who should take the lead?

- In 2017, two surveys on attitudes towards recycled nutrient products were made in Finland, one for farmers and the other for biogas plant operators
 - Farmers want inexpensive products which can be used as they are accustomed to with mineral fertilisers
 - -> reluctant to change
 - Biogas plant operators think their current products are comparable with mineral fertilisers and deserve a proper price and there is no need to do more

-> reluctant to change

Both want the *decisionmakers* to make clear strategies on how nutrient recycling should be taken forward

-> some exist, are they clear enough?

Who is <u>ready</u> to take the lead?



Be brave!

- Finland is moving forward, a lot is being studied and demonstrated
- Still, willingness to modify own habits and to invest into processing more refined fertiliser products remains low
- Willingness to change and courage to take on new things needs to grow – applies to all stakeholders involved
- Take a look in the mirror!





SYKE





Ympäristöministeriö Miljöministeriet Ministry of the Environment



Thank you!

sari.luostarinen@luke.fi



