



Baltic Slurry Acidification



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Potential of slurry acidification technologies, benefits and effectiveness of the technology

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The logo for Organe Institute ApS, featuring the word "Organe" in a large, white, sans-serif font with a green shadow effect, and "Institute ApS" in a smaller, white, sans-serif font below it, all set against a green triangular background.

SATs **for**
clear waters (and clean air)


Policy recommendations

SWOT matrix

- The SWOT matrix is used for visualising slurry acidification from a macroeconomic and political perspective.
- The SWOT matrix requires **clarification of objectives** and is **separating purely internal affairs from the context**, which in this connection is the individual countries and international affairs (EU, HELCOM, UN, etc.) respectively.



Farmer objectives

- An inherited, basic objective for a normal, commercially operated farm business would be economic survival, and the best guarantee for this be **maximisation of the profit**.
- In the perspective of farms, SATs affects their business economy via:
 - Investments – SAT installations, avoided investments in (solid) cover systems, tanks
 - Operational costs and revenues – higher crop yields, higher subsidies, costs for sulfuric acid, lower expenses on N and S fertiliser, higher need for liming??, avoided costs for injection, (costs for fuel, electricity and labour is minor),
 - Corrosion of concrete??, labour accidents?? 

IMPORTANT

+ - 0

Yield effect in Lithuania

- 16% higher yields in barley, grassland 13% higher yields, but spring wheat -6%, and almost no effect on corn and oats.
- Based on a season with atypical weather conditions.

Fertilising is acidifying soils!!

- The table is from a publication prepared by University of Adelaide, showing that (almost) all fertilising is acidifying soils.
- The question is whether acidified slurry is acidifying soils more than other fertilisers? We did not experience that in general, neither from Lithuanian field trials.

Table 1. Acidification potential for various N, P and S fertilizers expressed as kg lime equivalent per kg of N, P or S applied or on a product weight basis (MES versus MAP).

Fertilizer	Acidification potential	
	kg lime equivalent to neutralize acidity per kg N	
<i>Nitrogen fertilizers</i>	If all nitrate leached	If all nitrate taken up
NO ₃	0	-3.6
NH ₄ NO ₃	3.6	0
Urea	3.6	0
Liquid NH ₃	3.6	0
SoA	7.1	3.6
MAP (pH > 7.7)	10.7	7.1
MAP (pH < 6.7)	7.1	3.6
DAP (soil pH > 7.7)	7.1	3.6
DAP (soil pH < 6.7)	5.4	1.8

Lithuanian CoGAP from 2001

- Section 2: Soil analyses should be made every 5 years.
- Section 3: “Soil liming ensures effectiveness of all other agrotechnical measures especially fertilisation. Liming leads not only to neutral soil acidity, but also to good soil structure, water regime, low resistance to agricultural equipment, higher amount of mobile phosphorus, potassium, nitrogen, sulphur, calcium and magnesium, and lower amount of mobile aluminium that is hazardous for plants. Liming activates beneficial, especially N-fixing, micro-organisms and stimulates activity of ferments. Soil liming is also useful from environmental protection point of view. **Lime neutralises acid residues of mineral fertilisers**, hinders penetration of radionuclides and heavy metals”

Society objectives related to slurry acidification - ammonia emissions

- Figures on adjusted ammonia emissions in the years 2014, 2015 and 2016, as well as ceilings for 2020 and 2030 for the eight EU Member States in the Baltic Sea Region as well as national totals for Russia and Belarus. The table also shows the distance to the ceilings, calculated as the percentage of needed emission reductions from 2016 to 2020 and 2030. (Main source: <https://cdr.eionet.europa.eu/>)

Country	2014	2015	2016	2020	2030	2020	2030
	Adjusted emissions, Kt			Defined ceilings, Kt		2016 distance to ceiling, % of ceiling value	
BY*	141.17	142.64	136.06	126**	126	-8	-8
DA	66.16	66.84	67.12	63.25	63.25	-6	-6
DE	601.47	609.68	601.50	593.83	443.81	-1	-36
EE	12.07	12.60	11.92	10.62	10.62	-12	-12
FI	31.65	30.09	29.72	29.88	29.88	1	1
LV	16.64	16.39	16.25	14.75	14.75	-10	-10
LT	34.60	34.72	34.03	34.12	34.12	0	0
PL	269.86	267.31	267.11	296.58	248.65	10	-7
RU*	840.12	882.37	900.25	-	-		
SE	54.41	54.3	53.1	49.25	48.09	-8	-10
TOTAL	1,228	1,235	1,217	1,218	1,019	-	-

Society objectives related to slurry acidification – nutrient loads to the Baltic Sea

- The table shows HELCOM obligations (CART – Country Allocated Reduction Targets)

Source: HELCOM

Country	2007	2013	2014	
	Country-Allocated Reduction Targets for all sub-basins, Kt/a		Extra reduction (total input) compared to ceilings for Baltic Sea basins since 1997-2003, Kt/a	Missing reduction (total input) to fulfil ceilings for Baltic Sea basins since 1997-2003, Kt/a
DA	17.21	2.89	10.17	0
DE	5.6	7.17 +0.5	3.36	7.28
EE	0.9	1.8	0.90	1.08
FI	1.2	2.43 +0.6	0.33	1.72
LV	2.56	1.67	7.22	5.40
LT	11.7	8.97	0.04	18.51
PL	62.4	43.61	0.10	27.54
SE	20.78	9.24	15.97	1.87
RU	6.97	10.380	0	24.72
Transboundary Common pool (including BY)	3.78	3.32	0	11.11
		1.98	0	7.40

Society objectives related to slurry acidification – climate change

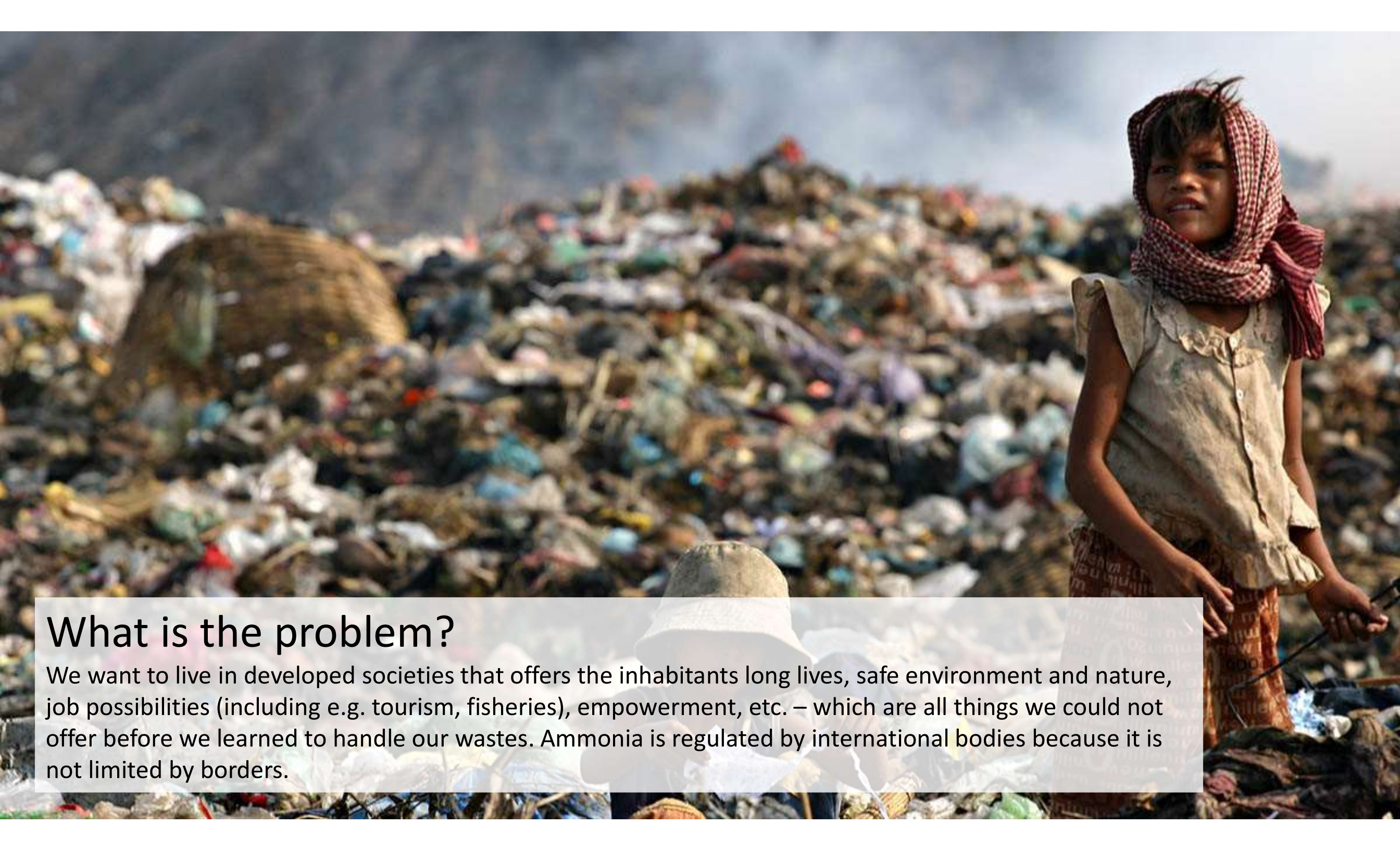
- Only DE is under the target for 2020, whereas all countries have to reduce GHG emissions until 2030.

Country	1990*	2005*	2015*	2020**	2030**
	Actual emissions, MtCO _{2e}			Effort-sharing decision, % in relation to 2005-emissions / ceiling, calculated as MtCO _{2e} ***	
DA	72	69	51	-20 / 55	-39 / 42
DE	1,263	1,015	927	-14 / 873	-38 / 629
EE	41	19	18	11 / 21	-13 / 17
FI	72	71	58	-16 / 60	-39 / 43
LA	26	12	12	17 / 14	-6 / 11
LT	48	23	20	15 / 26	-9 / 21
PL	487	400	388	14 / 456	-7 / 372
SE	73	69	56	-17 / 57	-40 / 41
IALT	2,082	1,677	1,530	-	-

* Source: http://ec.europa.eu/eurostat/statistics-explained/index.php/Greenhouse_gas_emission_statistics_-_emission_inventories

** Source: https://ec.europa.eu/clima/policies/effort_en

*** Own calculations.

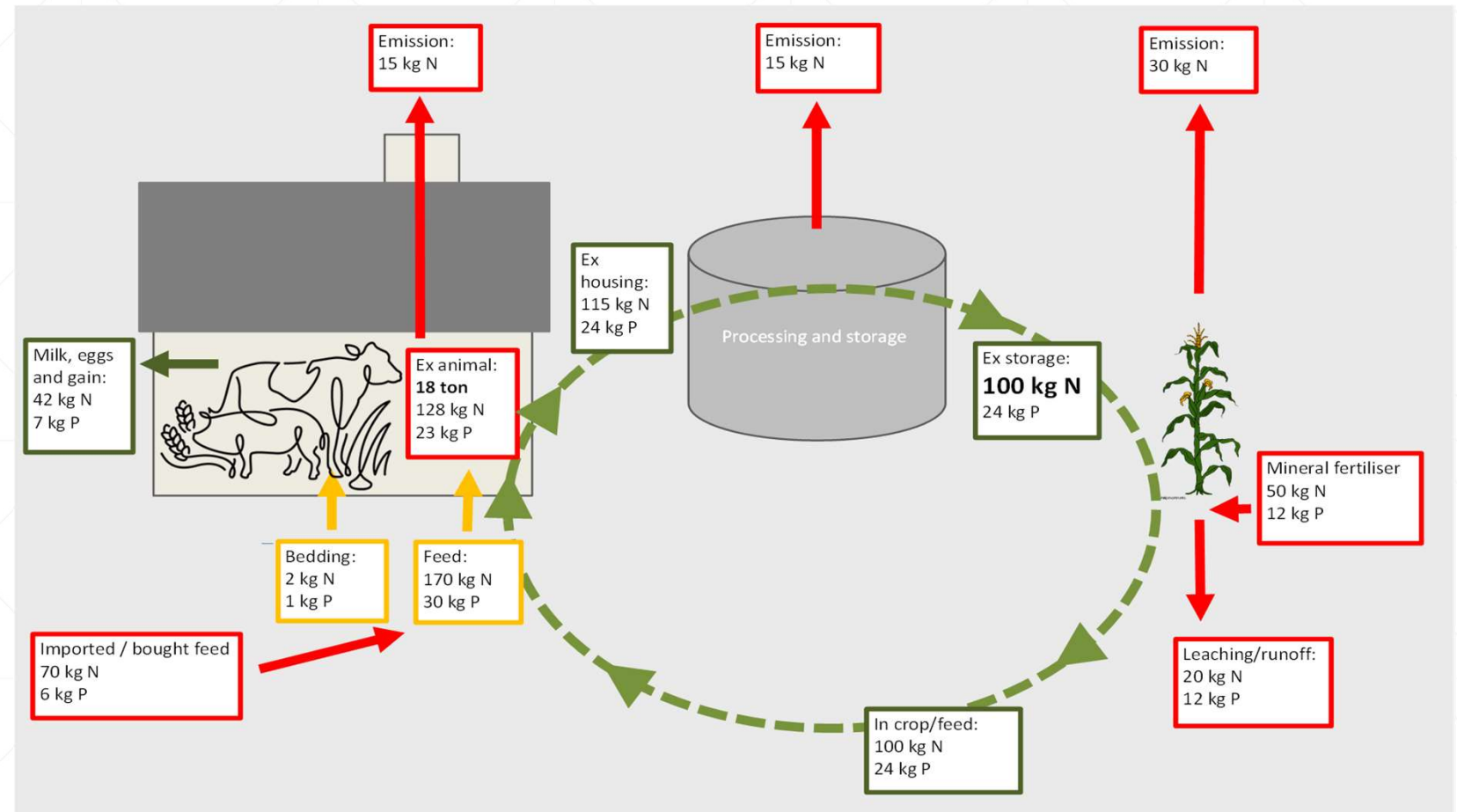


What is the problem?

We want to live in developed societies that offers the inhabitants long lives, safe environment and nature, job possibilities (including e.g. tourism, fisheries), empowerment, etc. – which are all things we could not offer before we learned to handle our wastes. Ammonia is regulated by international bodies because it is not limited by borders.

Pollution from livestock farming / manure

- Circular economy means that all red boxes shall be 0 (maybe except bought feed)
- Slurry acidification has positive effect on most red boxes (besides other positive effects)



Weighed potential for slurry acidification

Country	Weighed potential for slurry acidification, million tonnes of slurry*	Other strengths
BY	14.3	-
DA**	25	SATs are developed in Denmark, where they are well-known and used on beforehand, which is an advantage in case of upscaling. SATs are officially recognised as BATs that livestock farms can use for obtaining environmental permits.
DE	159.5	-
EE	1.1	Farmers are aware of the benefit of reducing ammonia emissions and inject about 60% of slurries although no legal requirement exists.
FI	3.9	-
LA	0.9	-
LT	1.5	-
PL	21.6	-
RU	3.3	-
SE	13.4	-
TOTAL	244.5	Experience and commercial solutions are available in the Region.

Annual value of realising the use of SATs for the weighed slurry potential. All figures in M€.

Country	Avoided EU penalty related to ammonia, M€	Savings in the healthcare sector, M€	Value of reduced greenhouse gas emission, M€	Annual costs of investments in SAT installations, M€	Net value, M€	Additional, estimated value of N abatement, M€*
BY	NA	(102**)	1.9	-13.2	-11.3	9
DA***	1.7	58	1.9	-12.1	45.6	9
DE	11.8	2,105.4	23.1	-147.3	1,993.0	100
EE	0.4	2.0	0.2	-1.5	2.0	0.7
FI	0	7.0	0.6	-3.6	4.0	2.5
LV	0	2.2	0.1	-0.8	1.5	0.6
LT	0	1.8	0.2	-1.4	0.6	0.9
PL	0	155.5	3.1	-19.7	138.9	13.6
RU ¹	NA	(5.9****)	0.5	-3.0	-2.5	2.1
SE	2.7	56.3	1.	-12.4	48.5	8.4
TOTAL	16.6	2,388.2 (+107.9)	33.4	212.7	2,220.3	147

15 regions in the North-Western part of Russia.

Annotations

** The estimated reduced airborne deposition would further have a considerable value for the society according Hautakangas et al. (2014) and Sutton et al. (2011). The abatement costs is varying, dependent on sector and other pre-conditions, and we have here assumed it to be only € 2 per kg N.*

*** Savings in the healthcare sector was not assessed for Belarus by Sutton et al. (2011), and we have assumed the value to be the same as for the neighbour country Poland, but the figure is not included in the net value for Belarus of using SATs and is therefore placed in brackets.*

**** For Denmark, all figures are based on Foged (2017), assuming half of the Danish slurry production is acidified, which is about 17 million tonnes of slurry, whereas the weighed potential for Denmark is 25 million tonnes of slurry.*

***** Savings in the healthcare sector was not assessed for Russia by Sutton et al. (2011), and we have assumed the value to be the same as for the neighbour country Finland, but the figure is not included in the net value for Russia of using SATs and is therefore placed in brackets.*

Recommendations

- Our recommendation is to the eight EU Member States in the Region, including Lithuania, to implement the use of SATs.
- The immediate recommendation is to establish official expert work groups to consider the impacts of this, and the way to do it. Hence, we recognise that our analyses are made without consideration to the specificities of the legal and institutional context in the individual countries.
- In Lithuania, I understand there is a chance for Animal Science Institute of Lithuanian University of Health Sciences to obtain funding for continuation of field trials with acidified slurry. I strongly support this, which is inline with our recommendations.

Politicians tools

Politicians have basically 2 tools for achieving a certain effect in the market:

- The carrot symbolises financial incentives / subsidies, as well as giving attractive advantages for certain actions = legal enablers.
- The whip symbolises regulations, penalties.
- It is in any case important that no legal barriers exists.



Disseminated use of SATs in Lithuania

- Due to the economy in slurry acidification in Lithuania, it will not be used on a voluntary basis if the farmers shall pay for the investments and operational costs.
- The use can be enforced via requirements in connection to issuing of environmental permits to intensive livestock farms*.
- Subsidies can be used as financial incentives.

* (2010/75/EU): *The permit should include all the measures necessary to achieve a high level of protection of the environment as a whole and to ensure that the installation is operated in accordance with the general principles governing the basic obligations of the operator. The permit should also include emission limit values for polluting substances, or equivalent parameters or technical measures, appropriate requirements to protect the soil and groundwater and monitoring requirements. Permit conditions should be set on the basis of best available techniques.*

BAT conclusions

Commission Implementing Decision (EU) 2017/302 of 15 February 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the intensive rearing of poultry or pigs (notified under document C(2017) 688) (Text with EEA relevance.) - https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2017.043.01.0231.01.ENG:

- **SATs are mandatory BATs in all EU Member States (all types of SATs – including in-house acidification, which is mentioned in table 2.1d and section 4.12.3)**
- **It appears from the EU Decision that (citation): “These BAT conclusions apply without prejudice to other relevant legislation, e.g. on animal welfare.”**

Overall conclusions

- SATs are, compared to other countries in the Baltic Sea Region, not having high potential for use in Lithuania.
- Presently, Lithuania does not need to reduce ammonia emissions in general.
- We can anyway recommend Lithuania to use SATs due to their positive effect in the health sector and other positive effects.
- SATs are BATs that intensive livestock farms can be requested to use as a condition for achieving of environmental permits.
- Wider use would require incentives given to (livestock) farmers.
- We have via our project demonstrated the in-field SAT in Lithuania, which makes it easier to spread the technology.

Thank you for your attention

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