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Integrated assessment of manure transport induced by European environmental regulations: a life cycle approach for liquid pig manure in Germany

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Motivation

- Manure is transported out of regions with high livestock density
- Transport is caused by the Fertilizer Directive (FD) that is currently revised
- Literature compares different manure transport and processing scenarios (e.g. Lopez-Ridaura et al. 2009)
- Missing:
  - Comparison of “no transport“ vs. “transport“
  - Influence of legislation causing transport

➔ Highly relevant because transports are likely to increase due to revised regulation

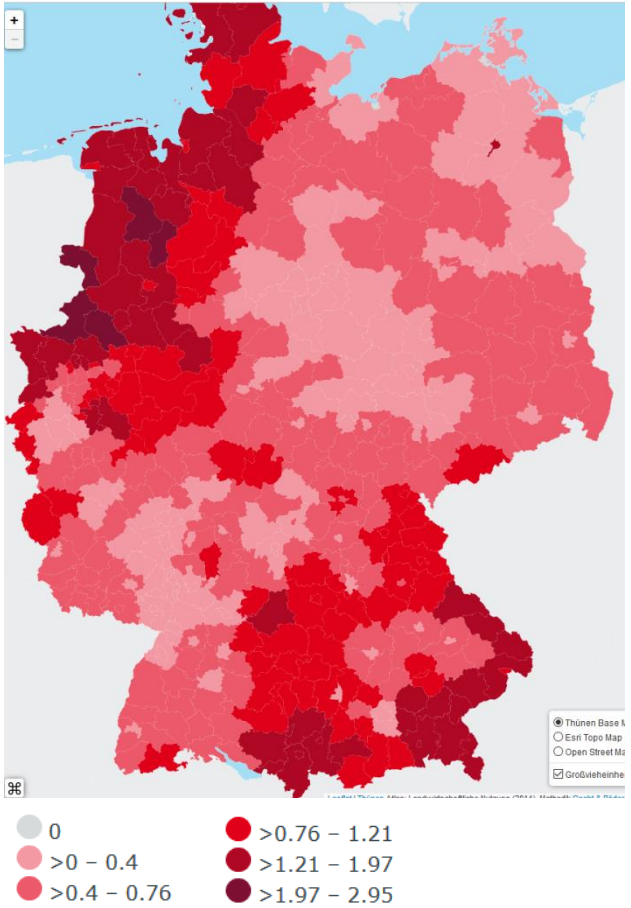


Figure 1: Livestock units per ha in Germany (TI 2014)

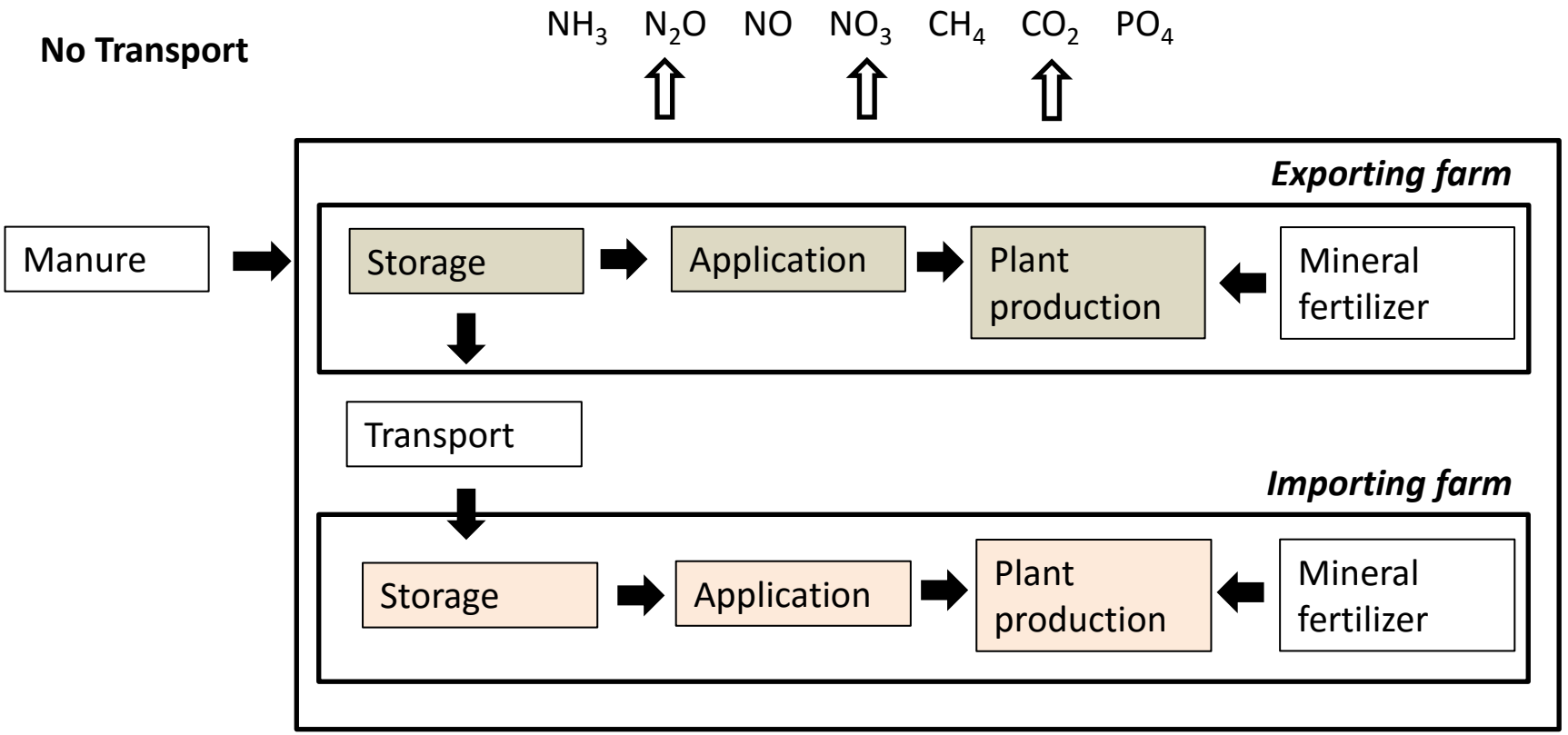
Material & methods

- Life cycle approach; functional unit of 1 m^3 liquid pig manure transported
- Lorry transport over 100 km from pig to arable farm, both growing wheat

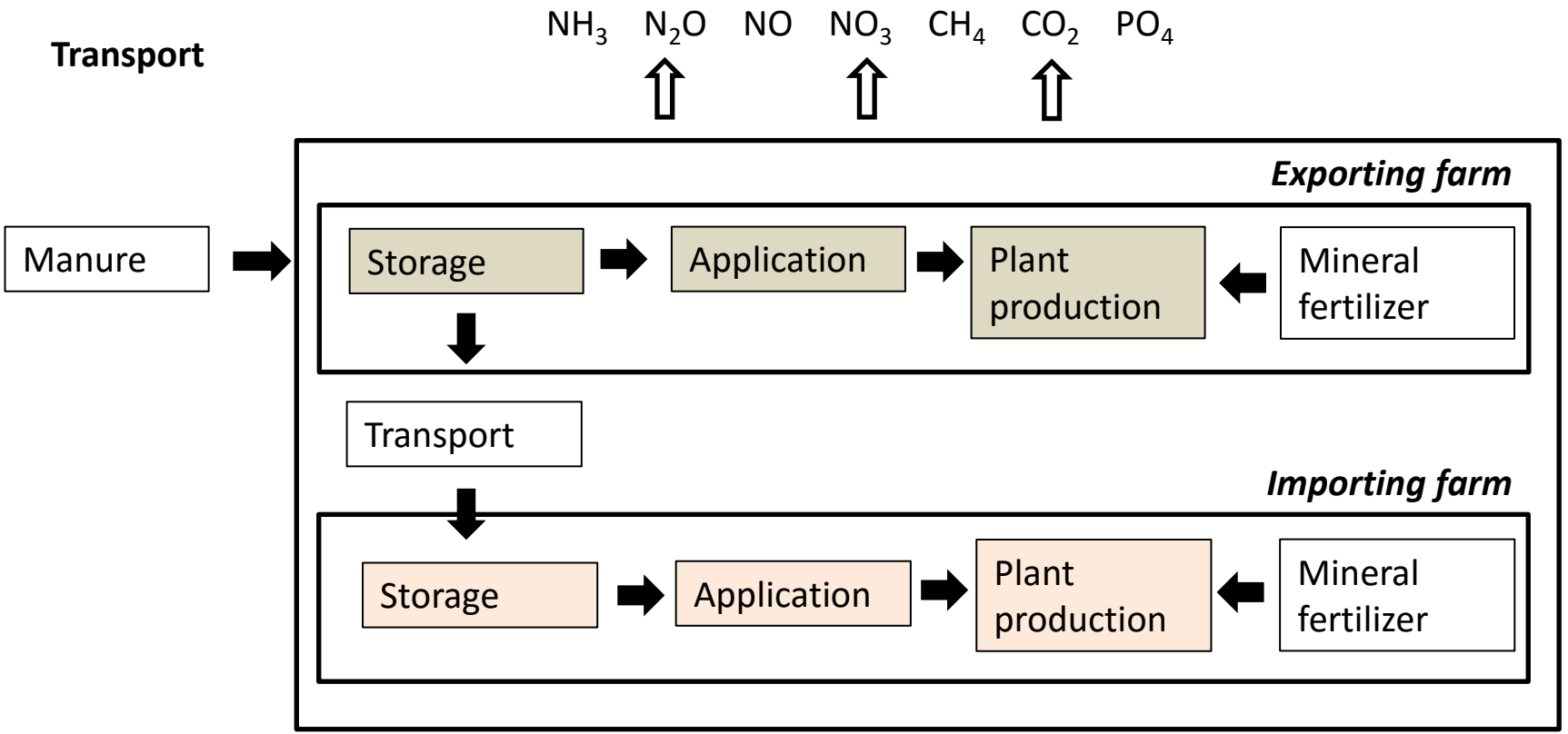
	Exporting farm		Importing farm
Scenario	**FD 2007**	**FD 2017**	**FD 2007 FD 2017**
Regulation causing export	**P surplus limit of 20 kg/ha**	**P surplus limit of 0 kg/ha**	**-**
Manure ex-/imported	**10.5 m^3/ha**	**(10.5+) 5.4 m^3/ha**	**25.0 m^3/ha**
Change of mineral fertilizer use	**No change**	**+21.2 kg N/ha**	**-85.0 kg N/ha -35.4 kg P/ha**

System boundaries & emission sources

No Transport



System boundaries & emission sources



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Results

	Climate Change	Terrestrial acidification	Freshwater eutroph.	Marine eutroph.	Particulate matter form.	Fossil fuel depletion
	kg CO_2 eq	kg SO_2 eq	kg P eq	kg N eq	kg PM_{10} eq	kg oil eq
FD 2007	-21.00	-0.26	-0.03	-0.12	-0.05	-1.69
	-0.43%	-0.11%	-1.10%	-0.44%	-0.16%	-0.92%
FD 2017	20.44	0.10	-0.02	-0.13	0.01	2.85
	0.56%	0.06%	-1.24%	-0.53%	0.03%	2.16%

Table 1: Change of environmental impact per m^3 manure exported

Results

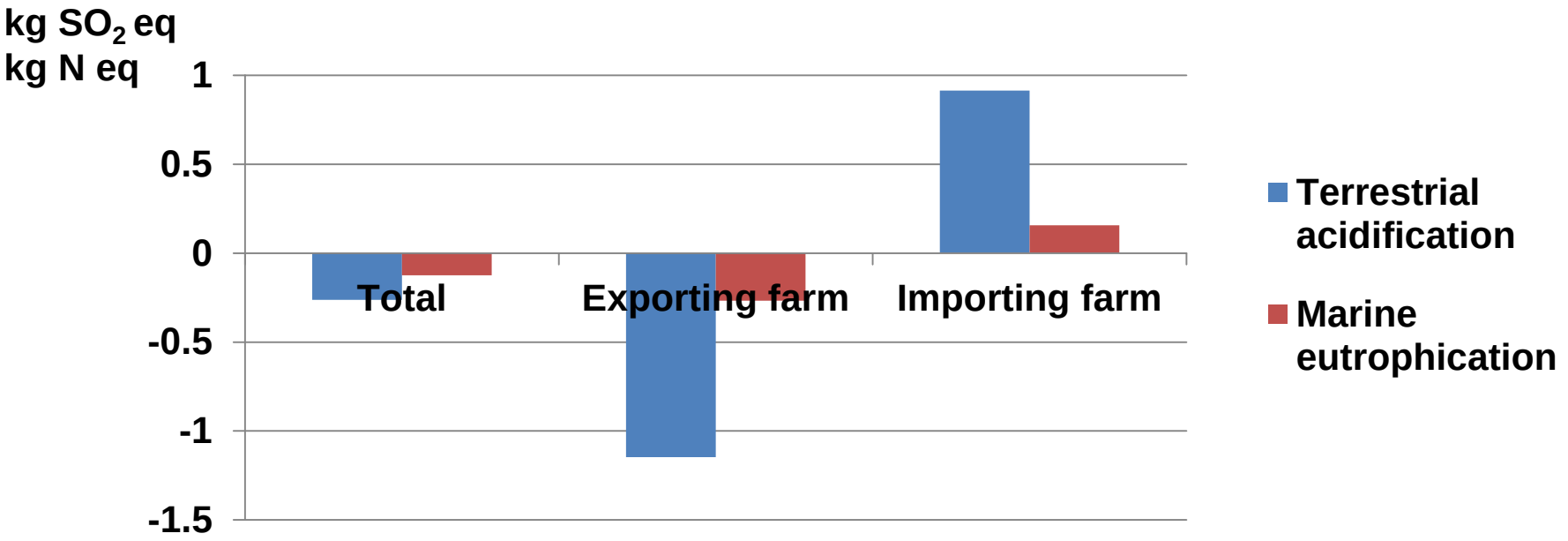

Figure 2: Change of TA and ME per m^3 manure exported in FD 2007

Conclusion

- Manure transport can reduce environmental pressure caused by livestock concentration
- Environmental impact depending on regulation triggering manure export
- Danger of pollution swapping (regional and between emissions)

➔ Regulatory gap in environmental law

Conclusion

- Manure tr… by livestock concentra…
- Environm… ure export
- Danger of… s)
  - ➔ Regula…

Thank you!

Questions or comments?

Conclusion

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➔ Regulatory gap in environmental law

References

Lopez-Ridaura, S.; Werf, H. v. d.; Paillat, J. M.; Le Bris, B. (2009): Environmental evaluation of transfer and treatment of excess pig slurry by life cycle assessment. *Journal of Environmental Management* 90 (2), pp. 1296–1304.

TI (Thünen Institut) 2014: Thünen Atlas: Landwirtschaftliche Nutzung Version 2014, availabe at https://www.thuenen.de/de/infrastruktur/thuenen-atlas-und-geoinformation/thuenen-atlas/ (30/11/16).