Resource Governance: A Case for Phosphorus

Interdisciplinary Circular Economy Conference 2020 M. Sc. / PhD candidate Lisa Harseim

Jun. Prof. "Transformation to Sustainable Energy Systems" Albert-Ludwigs-University, Freiburg lisa.harseim@enrlaw.uni-freiburg.de

Personal Background



in EL GAMALEYA, CAIRO

The Urban Footprints Project

Global Cities on a Low Carbon Path: Envisioning Systemic Change in Urban Metabolisms



THE LOCAL

RENEWARIES

DIMENSION OF THE NDCs

100% Renewable Energy



- "Urban Footprints" at the Junior professorship "Transformation to Sustainable Energy Systems", Albert-Ludwigs-Universität Freiburg
- Research Assistance: blockchain for resilience of food supply; ecosystem services and governance; "Economic Evaluation of Hamburg's Green Roofs"
- NGOs: World Wind Energy Association (WWEA), World Future Council (WFC)

The Phosphorus Nexus

Introduction

- Water: Planetary Boundaries, (renewable) Energy, Food production
- Social, economic & ecological
- Multi-scalar: local to global governance



The Hague, Netherlands

The Case Study

"What if The Hague cities could have a cumulative Delflan **impact** and change the system?" NASA (2015), algae bloom in the North

https://eoimages.gsfc.nasa.gov/images/im ea_tmo_2015157_lrg.jpg [Accessed 11 No

Setting a Direction

Problem Framing





Import-Export Balance

Global P Flows

• calculated from trade statistics of P rich food products

- export stress for all countries except for US (own P reserves)
- small P export losses of NL

Total P Trade			-	Niger	
Balance in t	Countries		0,08	Mali	
11,989,81	UnitedStates		0,08	CentralAfricanRepublic	
7,472,76	Brazil	_		Thailand	
4,423,97	Ukraine		•		
3,762,90	IvoryCoast		0,30	Afghanistan Pakistan	
2,144,68	Paraguay	-	0,31		
1,322,41	Ghana	-	0,36	Trinidad&Tobago	
1,313,03	Argentina	-	0,50	Kenya	
	Australia	-	0,54	Morocco	
873,19	Canada		0,77	Egypt	
826,34	Cameroon		1,07	Taiwan	9
821,35	Nigeria	-	1,19	Iran Osma) (anda	datc
655,72	Uruguay		1,44	CapeVerde	ion
270,97	Moldova	-	1,71	Ceuta	icat
258,87	Ecuador		2,07	KoreaRepublicof	lduq
246,50	SierraLeone	-	3,78	Mexico	Pre-publication
183,29	ChinaPeoplesRepublicof		4,73	Iraq	
102,49	Indonesia	-	5,30	Liechtenstein	2020.
97,76	Peru		5,53	Jordan	
97,06	Liberia		8,10	Israel	Haiseirn,
83,98	DominicanRepublic		8,75	lceland	
28,00	Myanmar	<u> </u>	12,80	Serbia	0
5,31	NewZealand		54,18	Lebanon	
4,85	India	-	75,32	Oman	
			76,33	Norway	
0,30	Yemen		76,42	Singapore	
0,17	Malaysia South Africa		91,40	Qatar	
0,03	SouthAfrica		451,46	UnitedArabEmirates	
fig Annual P im- and exports o	Niger		35,294,85	sum of P trade via food	(t)
$\mu \sigma$ Admini P im= and exports of	a i ne meinerlands via tood		• •		

fig. Annual P im- and exports of The Netherlands via food.

SFA of The Hague

Local Flows

mixed high-calorific incinerator ⇒(E) F61 waste (AVR) bottom ash F49 water provider solid waste organic river water F44 residual waste sorting collector residual waste solid F45 waste TH composting ->E (26) facility groundwater compost outflow organic waste TH natural 2% of all (E) aquifer organic waste drinking effluent water 33 digestate 34 organic waste TH biogas F43 reverse F22 digester osmosis greenhouse horticulture incinerator mixe 660 E waste TH (HVC) ottom 280 fertili slude ⇒(E) 51 Nieuwe produce households sewage treatment 51 Waterweg canal brackish effluent water food & trade & food & 1 drink 1,500 1,400 840 sewage retail drink import effluent North Sea E pipe produce 79 overflow North Sea domestic and other sewagedestination sources free leakage 46 produce urban rain export water run destination off (E) (E) E

Delfland & The Hague, 2019

Local P Regulation

Legal Framework



Substance Flows

Driving Factors

- Factors based on Metson et al., 2015*
- Links to Urban Metabolism



organic residual SW sW bottom ash mixed high-cal. SW residual SW TH crestdual SW TH compost org. SW to biogas org. SW to biogas org. SW to biogas org. SW to biogas compost organic SW TH mixed household SW TH mixed household SW TH sludge bottom ash brackish water organic SW TH studge bottom ash srindge bottom ash sri

*Metson, G. S., Iwaniec, D. M., Baker, L. A., Bennett, E. M., Childers, D. L., Cordell, D., Grimm, N. B., Grove, J. M., Nidzgorski, D. A. & White, S. (2015). Urban phosphorus sustainability: Systemically incorporating social, ecological, and technological factors into phosphorus flow analysis}. Environmental Science and Policy, 47, 1--11. https://doi.org/10.1016/j.envsci.2014.10.005

©Harseim, 2020: Pre-publication data Terment

Activating Measures

Substance Flows

©Harseım, 2020: Pre-publication data

- Improvement measures with cascading effects on flows
- Increasing or decreasing respective flows

wetland restoration ecological channels urban green landscaping green roofs & facades channel flushing channel sloping DEWATS in new settlements membrane filters in sewers horticulture outflow filter PMFC prototype adapt water use to plant demand STP effluent concentration stormwater management water level in polders evaporation by trickling no application zones nutrient retention in drainage gravity-based run-off buffers reduced lawn fertilization retention basins decoupling stormwater zoned area for agriculture close selected overflows plant filter before overflows free org. collection bags waste separation campaign after-separation filter grills in channels collection frequency SW pollution reporting reward SW collection fermentation of org. SW biogas production

residual SW TH digestate to incin. compost org SW TH to compost sugge bottom ash bracktsh water and household SW TH mixed household SW TH mixed household SW TH area household SW TH bracktsh water suffluent to sea STP effluent to sea serage sludge serage-free leakage verflow & other sourc urban run-off reverse somotis produce domestic use produce domestic use produce export produce export produce export produce filluent to aquifer tiver water river water groundwater outflow

Modes of Governance

Activating Measures

 Applicability of governance modes to flow measures



"Think Global – Act Local"

Policy Impact

- Local pollution reduced (PB)
- Increase P export potential (incineration)
- Reduce P imports due to circular supply (horticulture)



Takeaways

- P (and nutrients) are transdisciplinary subjects. Cities can change their urban metabolism despite limited legal scope of action if they collaborate across boundaries and sectors.
- **Polycentric governance** could have far reaching impacts and **local action** may pave a way towards **global transition for circularity**.
- Cities are embedded in a global network, likely linking substance flows and governance ties. Many governance failures may be alleviated by an accountability concept.

Accountability of Governance

Way Forward

- Detecting substance flow & governance links among world cities
- Identifying governance drivers
- Explore the potential of accountability towards circularity



Working title:

The role of world cities for accountable multi-scalar phosphorus flow governance in globalized food production

Keywords: urban studies, human geography, industrial ecology, environmental resource management, globalization



Thank you for your attention!

