Characteristics of source-separated household wastewater flows – a statistical assessment

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Aim of the study

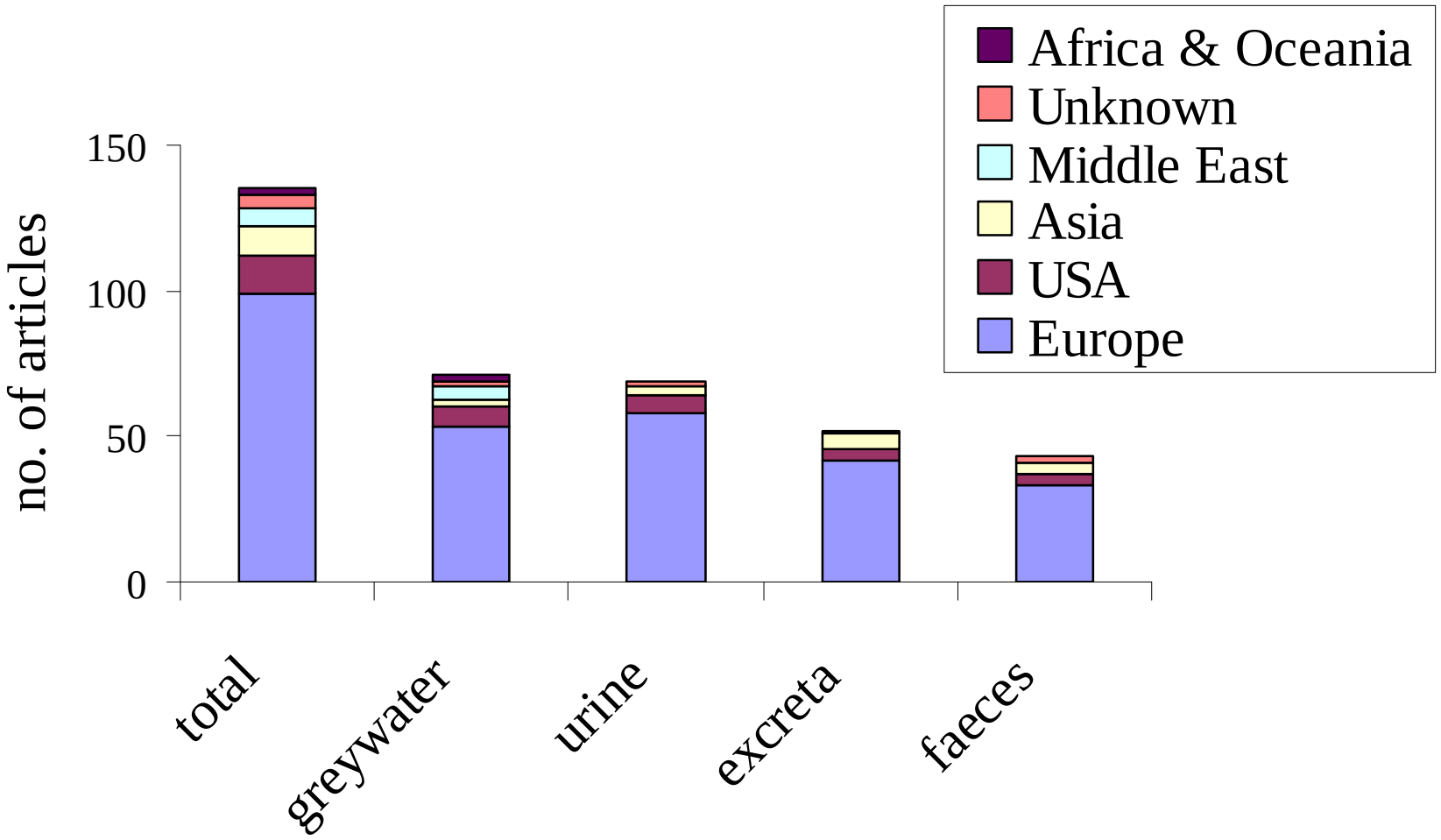
- Increasing number of projects and concepts using source-separated wastewater flows
- Knowledge about components of different flows important for
  - » Design of (treatment) facilities
  - » Assessment of recovery potential

- Design values for Swedish conditions available, DWA task group in Germany established

Approach of the study

- Collection of secondary information
  - » Scientific publications
  - » Project reports
  - » Personal communication
- Setting up of database based on >135 sources
- Organic matter, nutrients and heavy metals in urine, faeces and greywater (domestic wastewater)
- Analysis of loads (per person and day) and concentrations
- Statistical tests

Origin of data



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Focus of study on Central Europe, comparison with other regions

Challenges

- Dependence on quality of original studies
- Varying number of samples in references
- Disparities in analysis methods
- 100%-separation cannot be guaranteed due to, e.g.
  - » Time away from the home
  - » Insufficient separation effectiveness of toilet facilities
- Terms and definitions of wastewater flows vary

Definitions

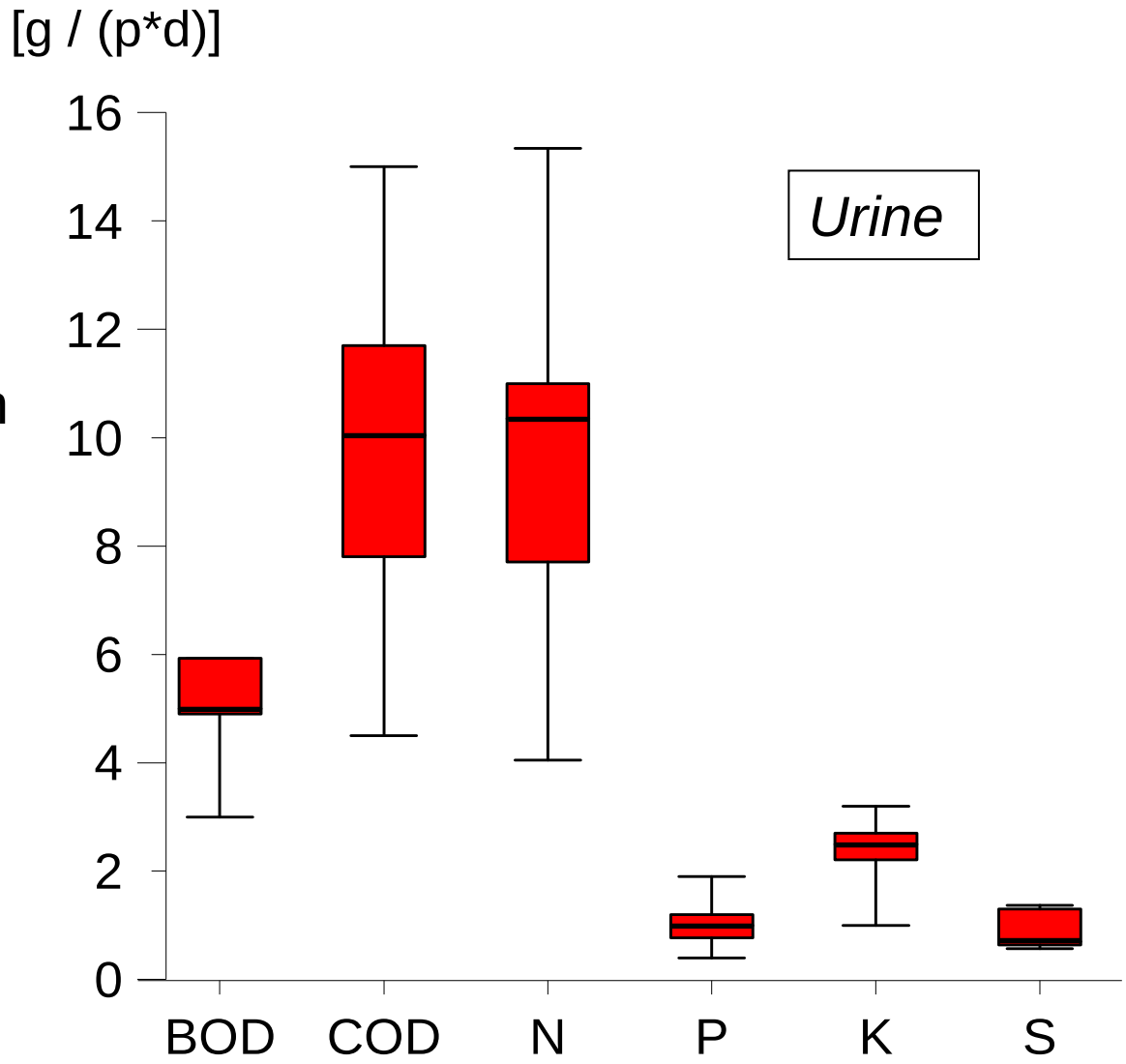
<table>
<tr><td rowspan="3">Toilet wastewater</td><td rowspan="2">without water</td><td>Urine</td><td>Faeces</td></tr>
<tr><td colspan="2">Excreta</td></tr>
<tr><td rowspan="2">with flushwater</td><td>Yellowwater</td><td>Brownwater</td></tr>
<tr><td colspan="2">Blackwater</td></tr>
<tr><td colspan="2">Domestic wastewater without toilet wastewater</td><td colspan="2">Greywater
(more sub-divisions for greywater are possible)</td></tr>
</table>

Results - Characteristics of urine

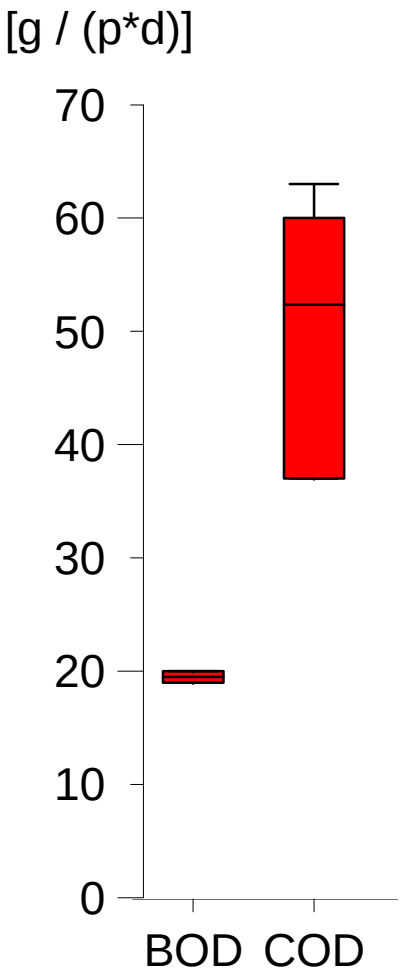
Fraction with largest amount of nitrogen and other nutrients

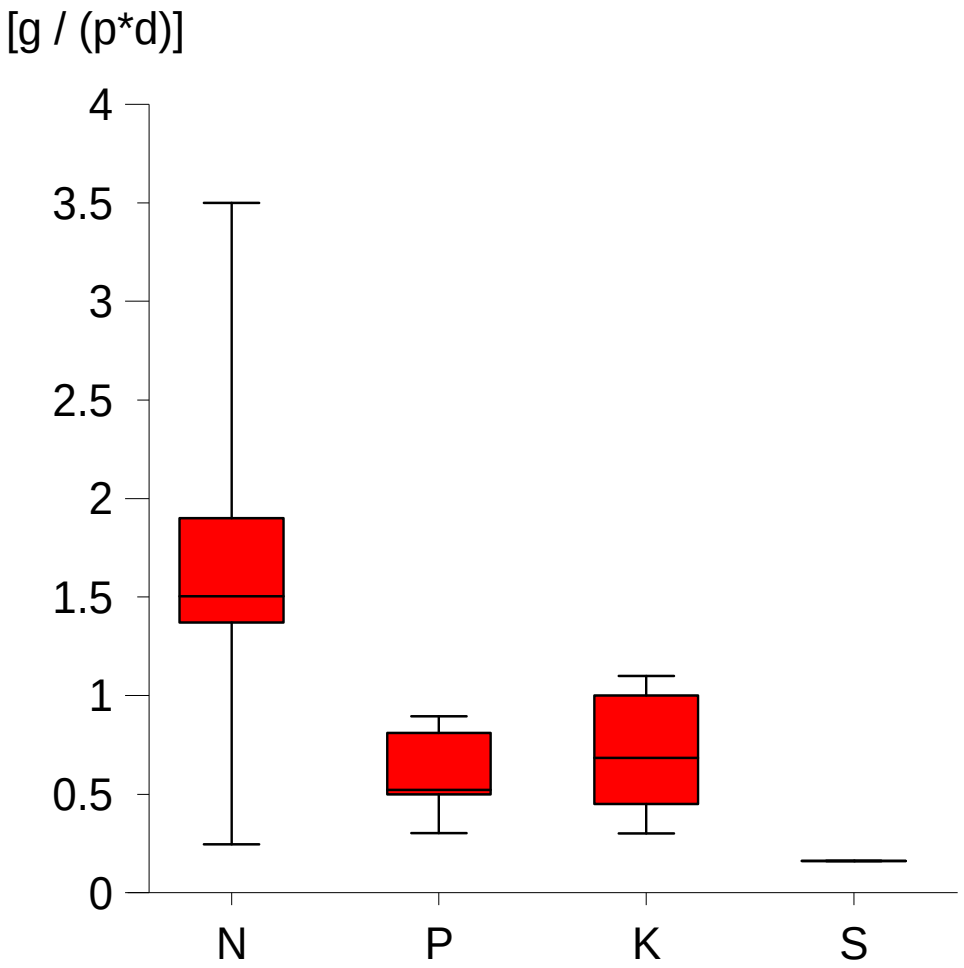
Relatively wide range of values, but median and upper/lower quartiles can be used as approximations

Factors that can impact on results: diet, time and place of sampling (storage) etc.,
but no correlation assessable



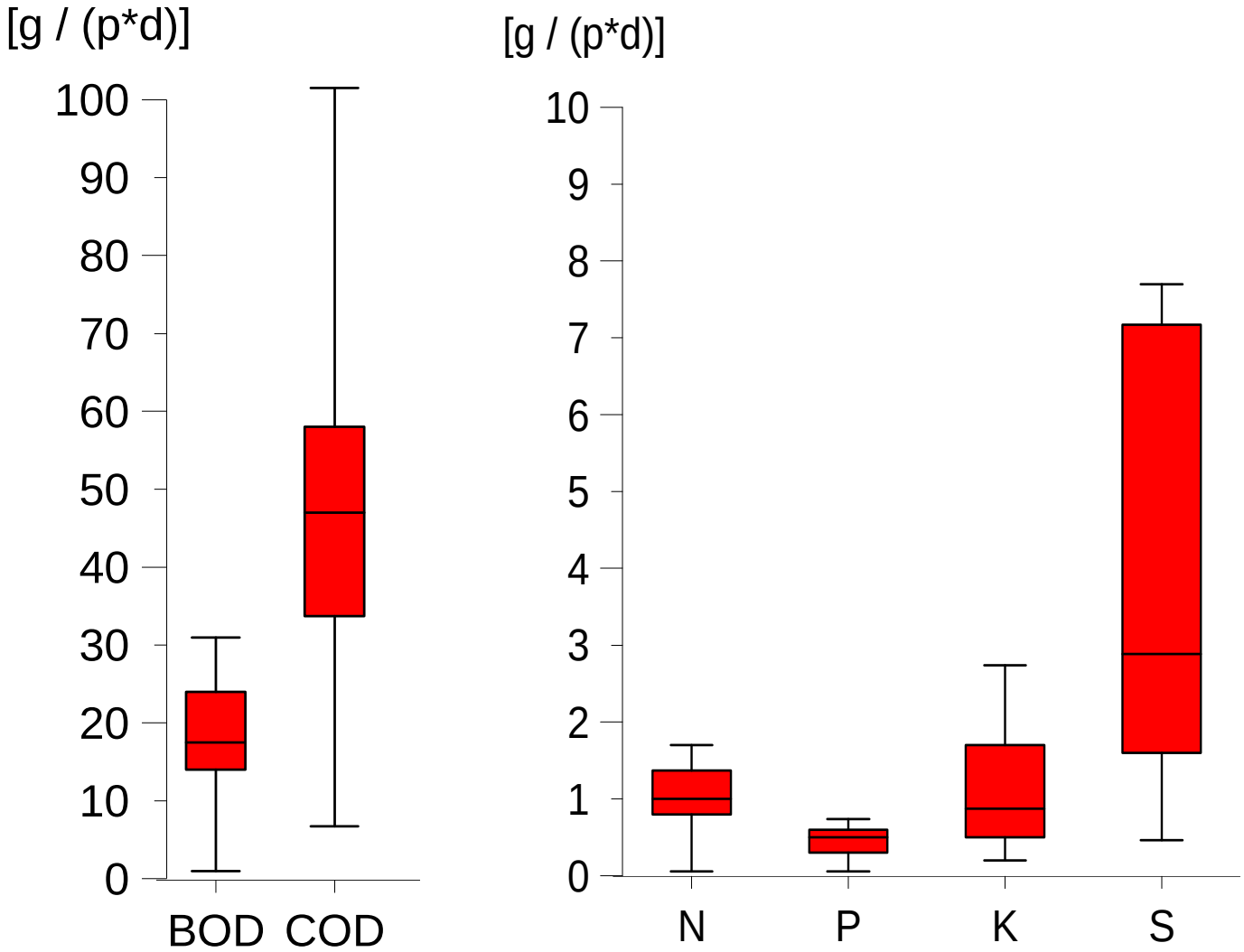
Characteristics of faeces



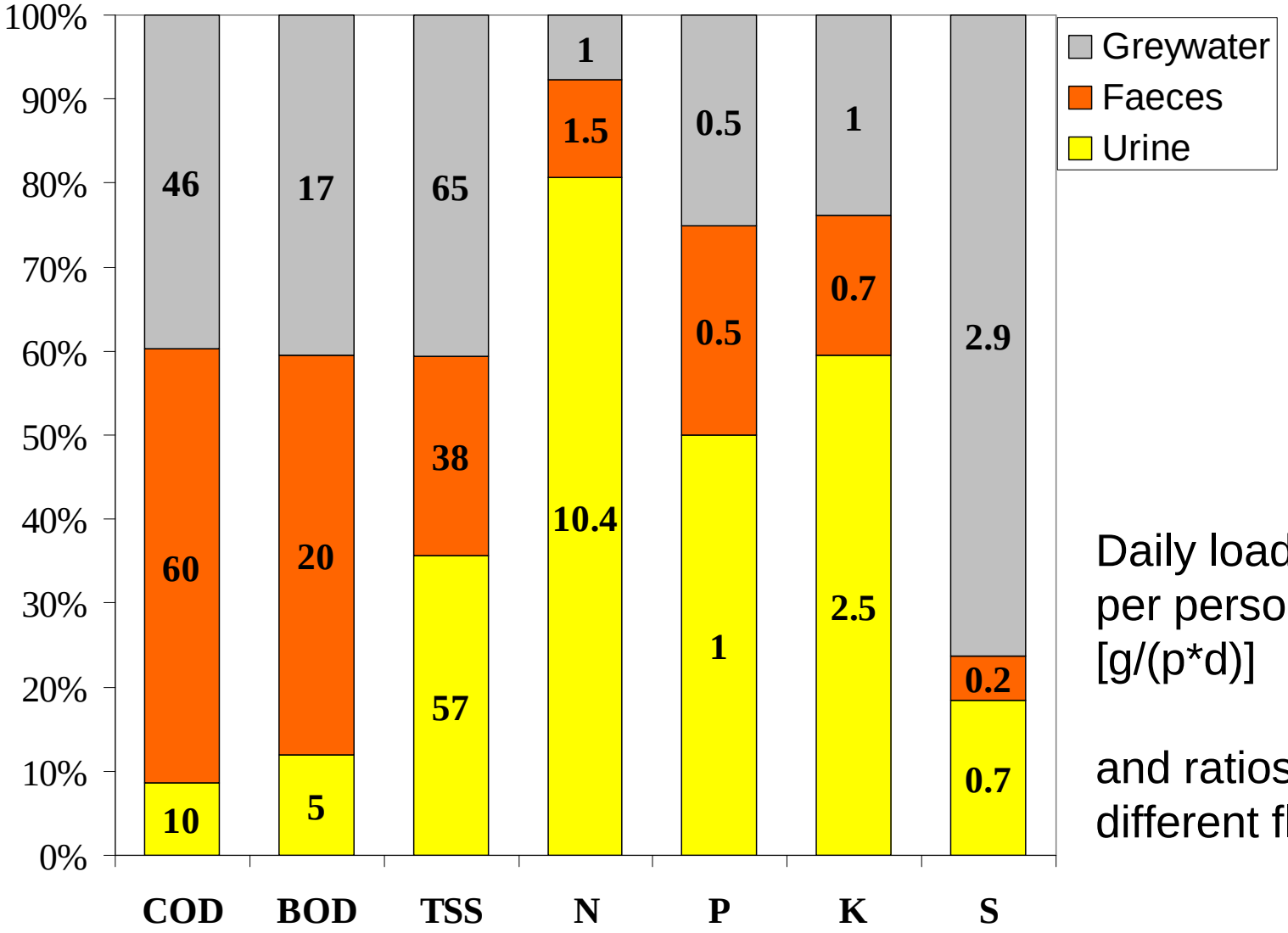


Please note: only 1 value for S

Characteristics of greywater



Results - Characteristics of the different flows



Daily loads per person [g/(p*d)]

and ratios for different flows

Results - Heavy metals in source-separated flows

mg/(p*d)	Pb	Cd	Cu	Cr	Hg	Ni	Zn
Urine	0.02	0.01	0.10	0.01	0.01	0.01	0.30
Faeces	0.02	0.01	1.10	0.02	0.02	0.07	10.7
Greywater	3.00	0.08	6.50	2.01	0.02	1.60	23.3

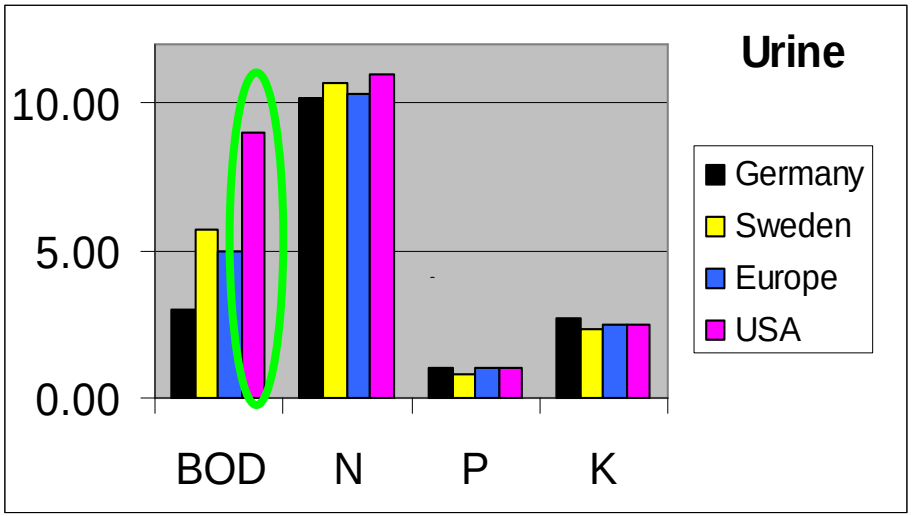
Data quality for faeces rather poor, for greywater fair and for urine good

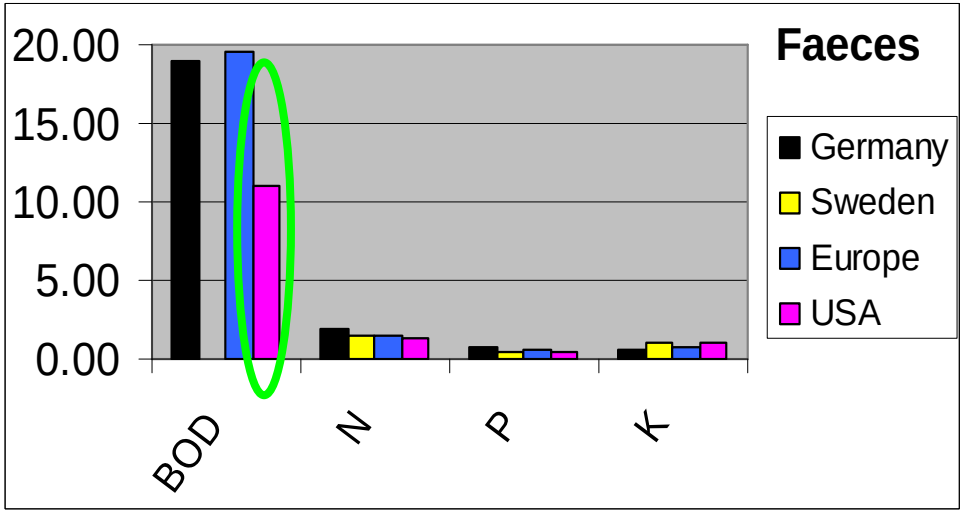
Comparison of urine application with limit values of sewage sludge directive (assuming 170 kg N/ha*y)

kg/ha*y	Pb	Cd	Cu	Cr	Hg	Ni	Zn
Urine	0.3e-3	2.4e-3	1.6e-3	2.4e-3	2.4e-3	2.4e-3	4.8e-3
Limit value	15	0.15	12	-	0.1	3	30

Regional variability - excreta

Organic matter and nutrient loads in urine and faeces in g/(p*d)

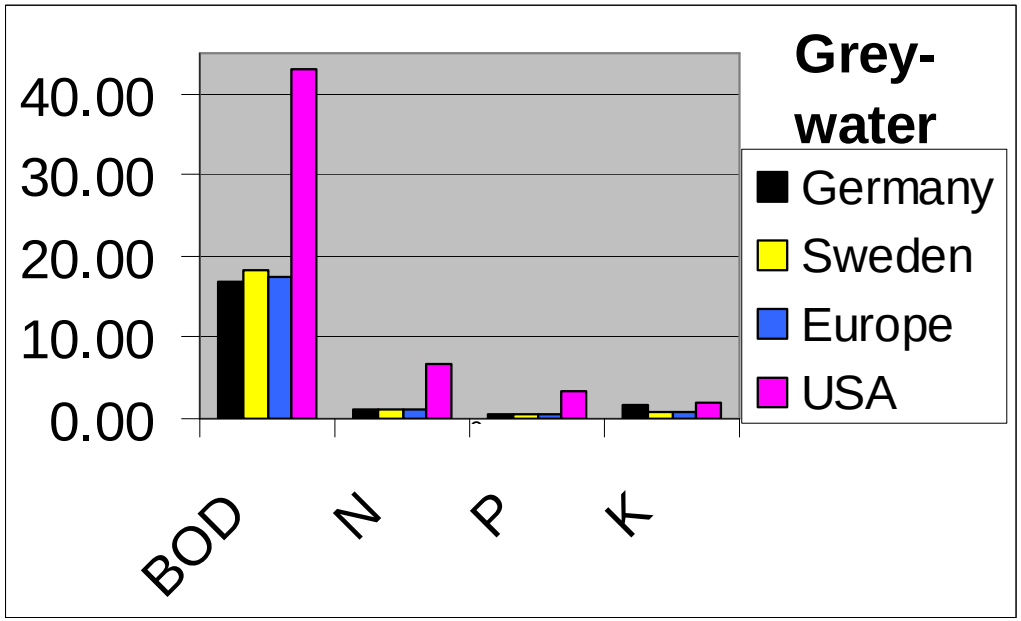




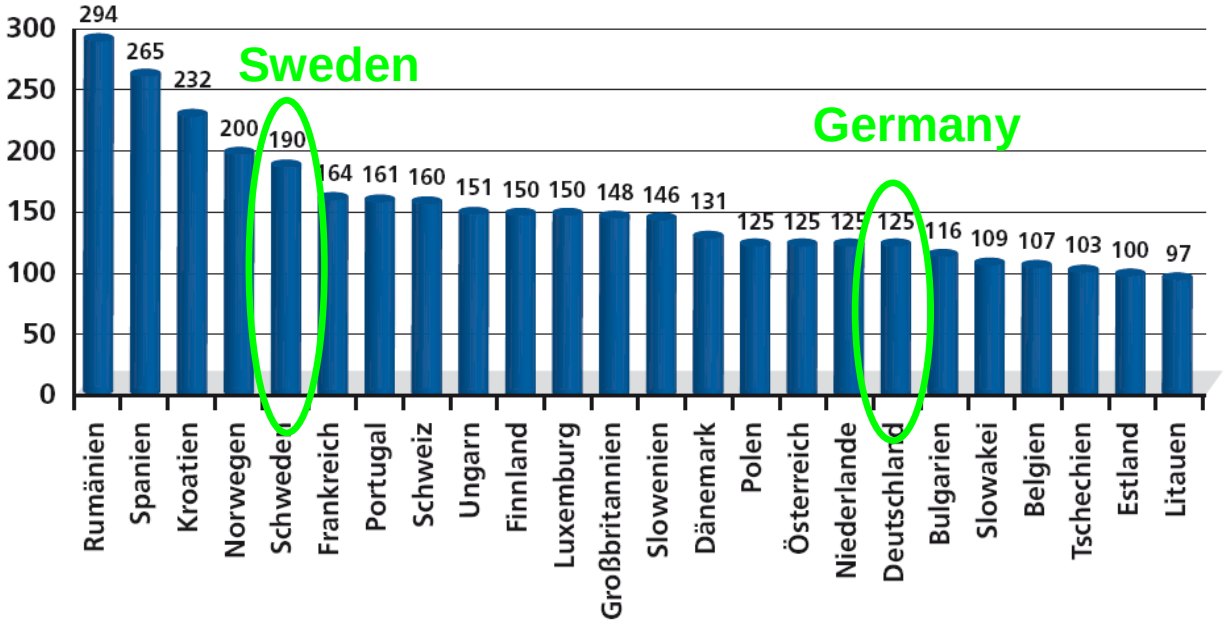
- Similar nutrient loads with slight differences across the countries
- Large discrepancy between BOD loads in USA and in Europe

Regional variability - greywater

- Water consumption in Sweden a lot higher than in Germany, daily nutrient loads in greywater similar
- Effect of kitchen waste grinders in USA -> higher BOD and nutrient loads in greywater



Organic matter and nutrient loads in greywater [g/(p*d)]



Water consumption in Europe [l/(p*d)] (Source: OFWAT, 2007)

Study	unit	Urin		Faeces		Greywater		Total		
		G	**S**	**G**	**S**	**G**	**S**	**G**	**S**	**A131**
Volume	l/(p•d)	**1.37**	1.5	**0.14**	0.14	**110**	100	-	-	**-**
TS	g/(p•d)	**57**	58	**38**	30	**65**	55	**160**	143	70
BOD_5	g/(p•d)	**5**	-	**20[b]**	-	**17**	26	**42[b]**	-	60
N	g/(p•d)	**10.4**	11.0	**1.5**	1.5	**1**	1.4	**12.9**	13.8	11[c]
P	g/(p•d)	**1.0**	1.0	**0.5**	0.5	**0.5**	0.5	**2.0**	2.0	1.8

[a] *G: presented study, S: Swedish design values (Vinneras et al., 2006), standard values for German mixed wastewater (ATV-DVWK A 131) (ATV-DVWK, 2000)*
[b] *without toilet paper*
[c] *Value as TKN*

Conclusion

- Database with wide range of design values available -> will be further updated
- Current evaluation can be used for establishing standard values for treatment (design guidelines) and nutrient/energy recovery
- Site-specific and regional variations possible:
  - » diet
  - » water use
  - » socio-economic & cultural factors
- Further extension proposed, particularly related to Non-European regions and including more differentiations

Thank you for your attention!

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