Citizen Science for Faecal Sludge Characterization in Blantyre, Malawi

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AfricaSan5 FSM5

Can Facebook and WhatsApp Improve Faecal Sludge Characterization?

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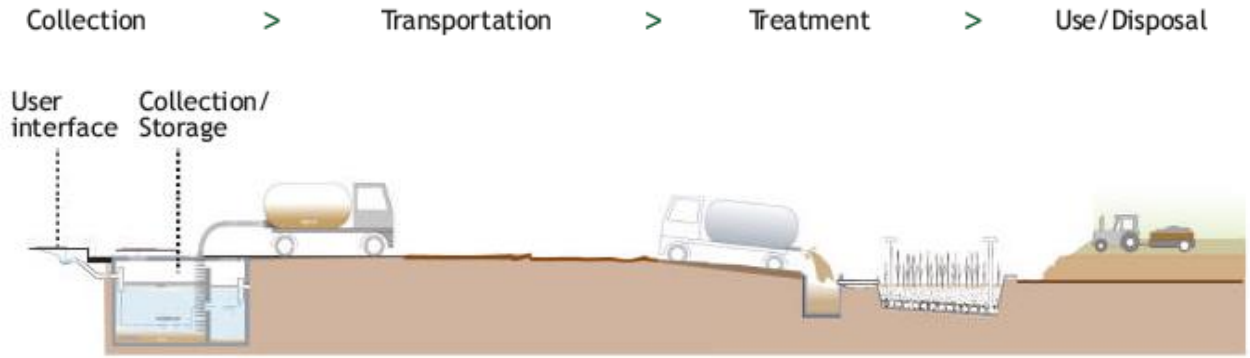
Background



[1]

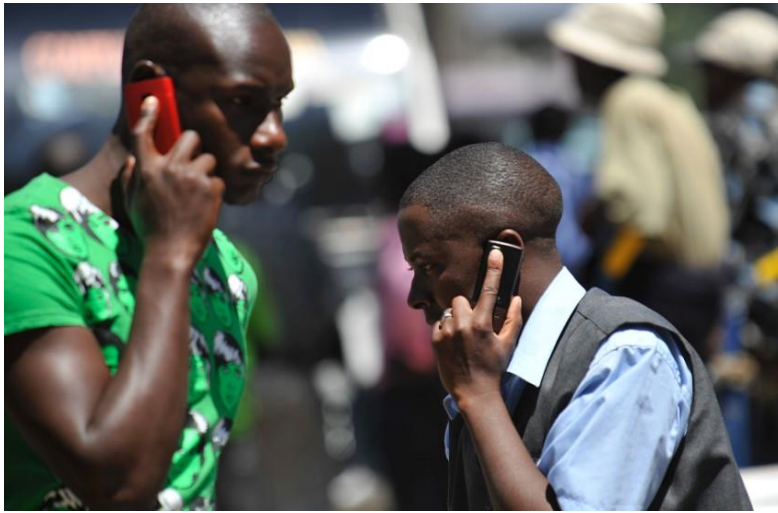
- **Improving on-site sanitation** in a community requires **data on quantities and qualities** of faecal sludge (FS) produced.
- **Existing tools** for FS data collection either **imprecise or costly**
- **Information and communication technologies** booming in low- and middle-income countries

→ Idea: **Use social media in a citizen science approach for FS data collection.**

Research Questions

1. Which **social media platform** is most suited to **collect sanitation data** via an online survey (demographics, cost)?

2. Can **FS characteristics** (TS, TSS, VSS, COD) be **predicted from a remote survey** distributed via social media?



[2]

Materials and Methods – Research Question 1

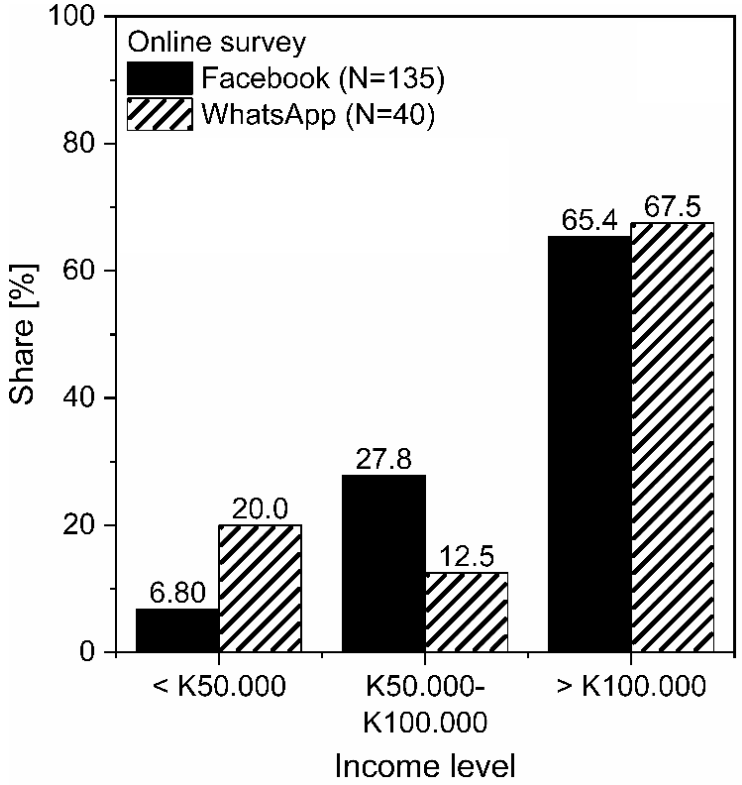
- **Study area**: Blantyre, Malawi
- **Online survey**: System type, toilet type, income, water connection, blackwater only, solid waste, # of users, shared toilet, emptying frequency
- **Modes of delivery**:
  - Facebook: Advertisement
  - WhatsApp: “Sanitation ambassadors”

Materials and Methods – Research Question 2

- **FS sampling** at 40 households during emptying of latrine/septic tank
- **Lab analysis**: Total Solids (TS), Total Suspended Solids (TSS), Volatile Suspended Solids (VSS) and Chemical Oxygen Demand (COD)
- **Data analysis**: Correlations among lab results and between survey and lab results

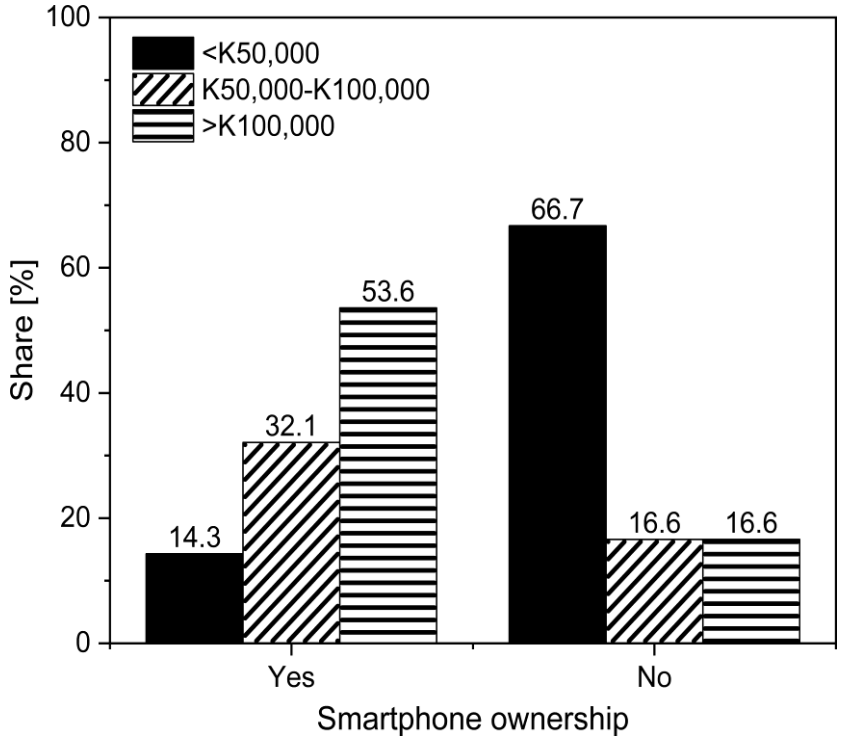
Results I – Demographics of Survey Respondents

- Both FB and WA introduce a **bias towards higher income households**.



Results I – Demographics of Survey Respondents

- Low-income households still lack access to smartphones and internet.



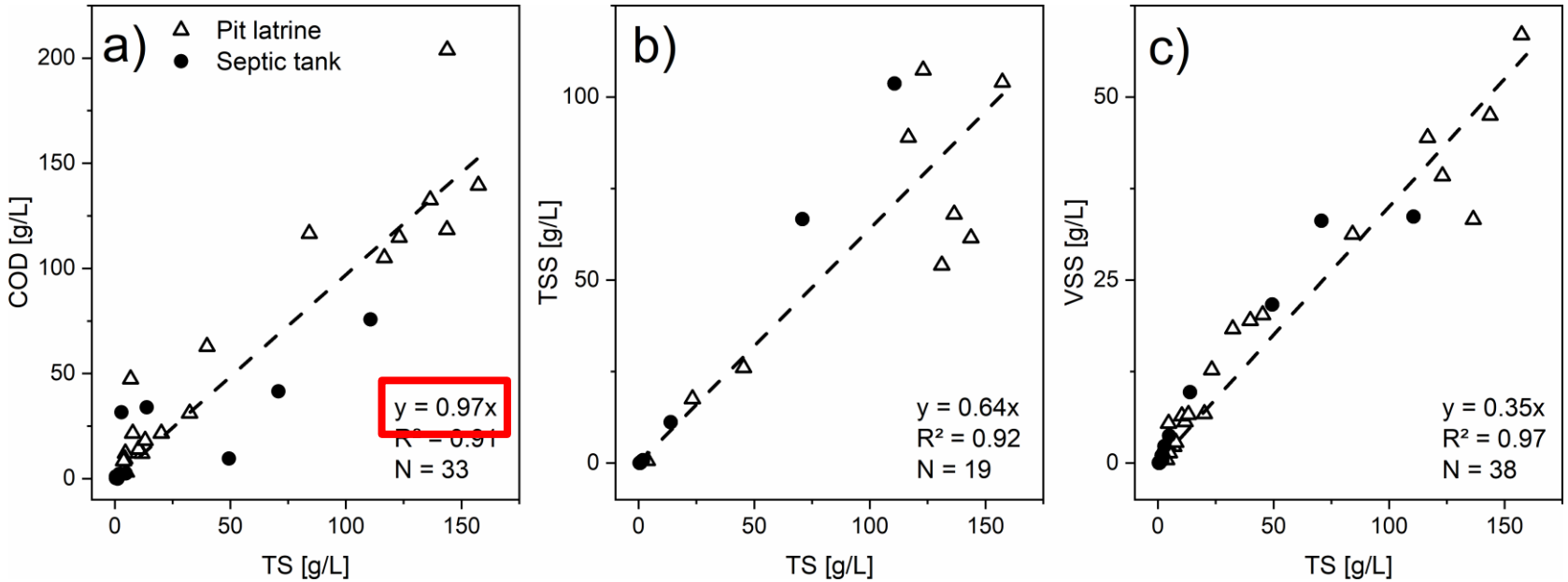
Results II – Cost-Efficiency of Modes of Delivery

- Data generation via **WA significantly cheaper than with FB** and conventional data generation

Mode of data generation	Cost per reply [€]
Facebook	3.00
WhatsApp	0.95
Conventional household interviewers [5]	1.47-2.20

Results III – Correlations Among Lab Results

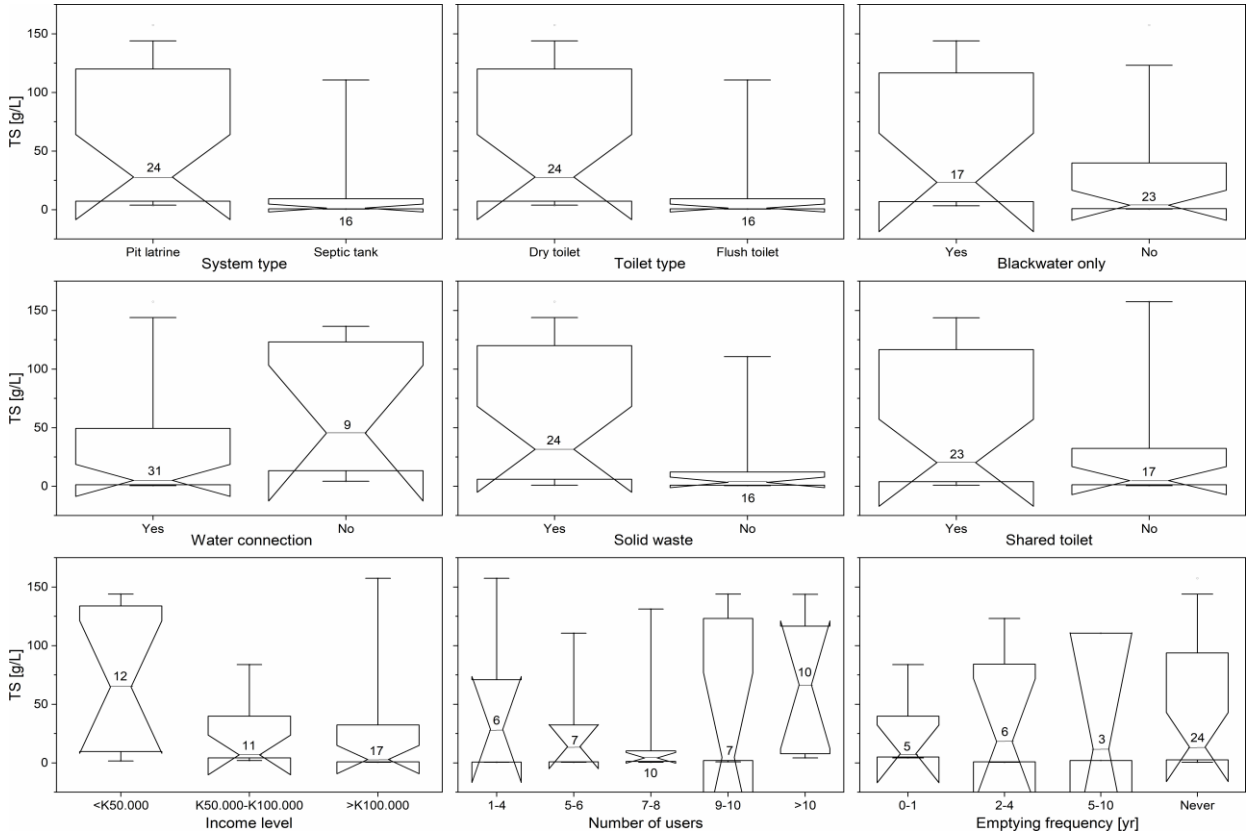
- **Significant correlations** of TSS, VSS and COD to TS



- **Slope** of COD to TS **similar to** the one found in **Uganda** by Strande et al. (2018) (0.97 vs. 0.88) [6]

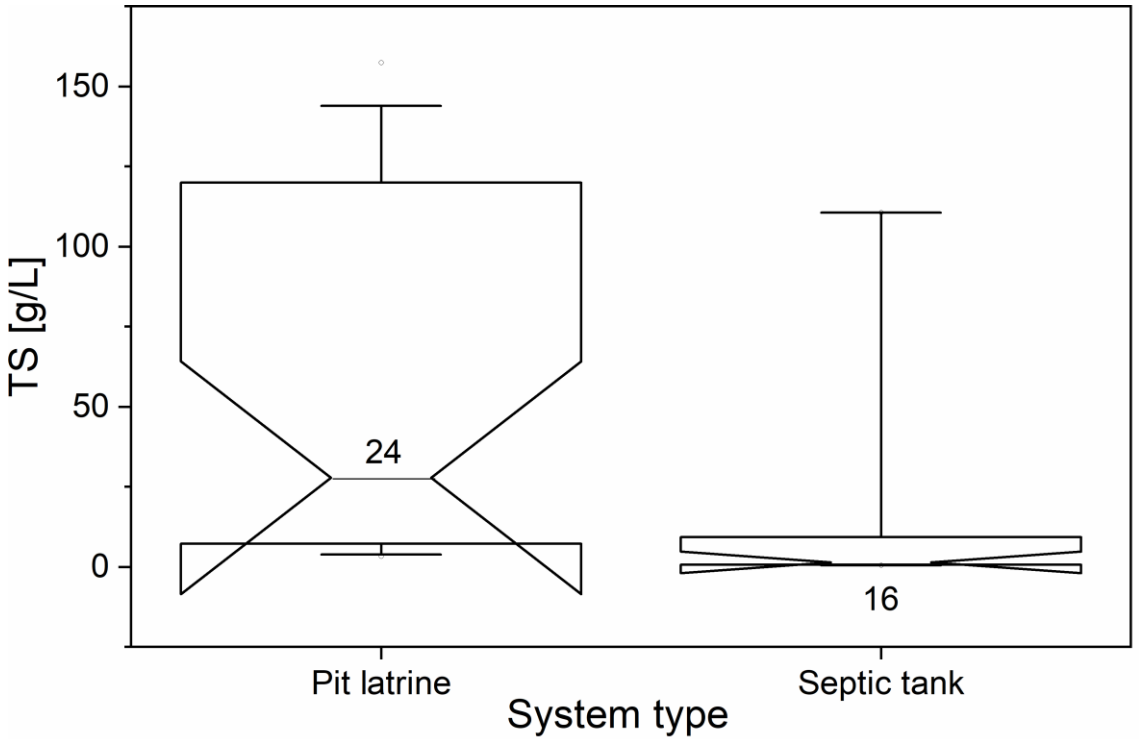
Results IV – Correlations Survey to Lab Results

- Total Solids



Results IV – Correlations Survey to Lab Results

- Total Solids



Results IV – Correlations Survey to Lab Results

- Summary of **all possible correlations**

	System type	Toilet type	Water conn.	Blackw. only	Solid waste	Shared toilet	Income level	# of users	Emptying freq.
TS	no	no	no	no	no	no	no	no	no
TSS	yes	yes	no	yes	yes	yes	no	no	no
VSS	yes	yes	no	no	yes	no	no	no	no
COD	no	no	no	no	no	no	no	no	no

- Strande et al. (2018) found non-overlapping CI for 7 parameters

The Bigger Picture – Using CS for FS characteriz.

1. **Social media can be used** to generate sanitation data **cheaply**, but at the moment they introduce a **bias** towards rich households.
2. Correlations between TS and COD/TSS/VSS might be **independent of local conditions**.
3. Some **survey parameters** show a **good correlation to FS qualities**, also hard-to-measure ones such as TSS or VSS.

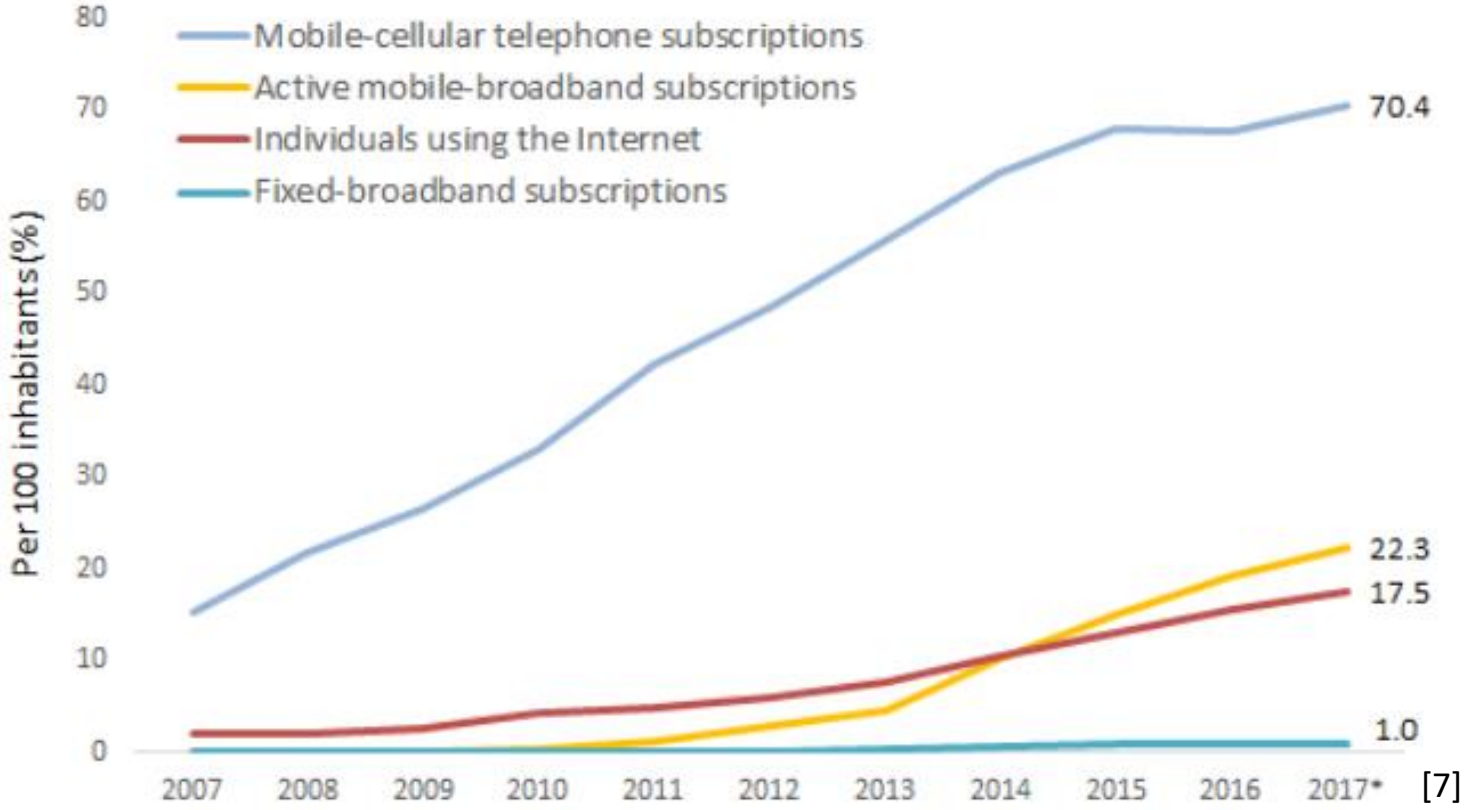
→ TSS/VSS/COD can be estimated from

- Measuring TS
- Assessing survey parameters through (online) survey

→ **Decision criteria**: Cost, sample size, target group

→ More research (and time) is needed!

The Bigger Picture – Using CS for FS characteriz.



[7]

Take-Home Messages

1. Both FB and WA can be used as platforms to collect sanitation data from a CS approach, but at the moment poor people still lack access.

2. TSS/VSS/COD can be estimated either from a correlation to TS or from an online survey.

3. Overall, using social media in a CS approach appears to be a promising new tool in the toolbox of FS characterization.

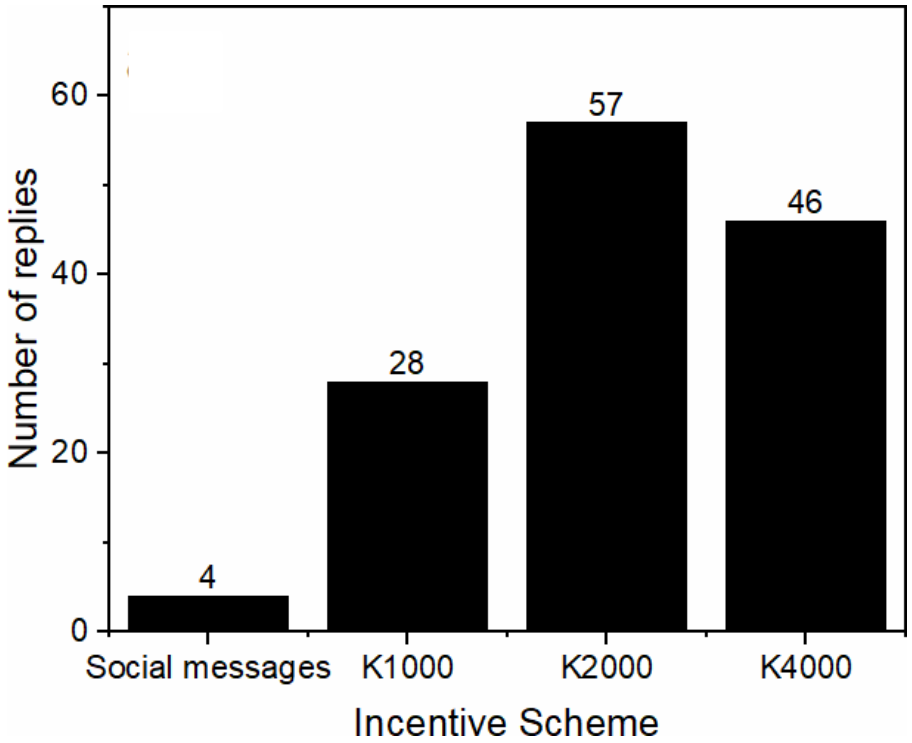
Thanks for your attention!

References

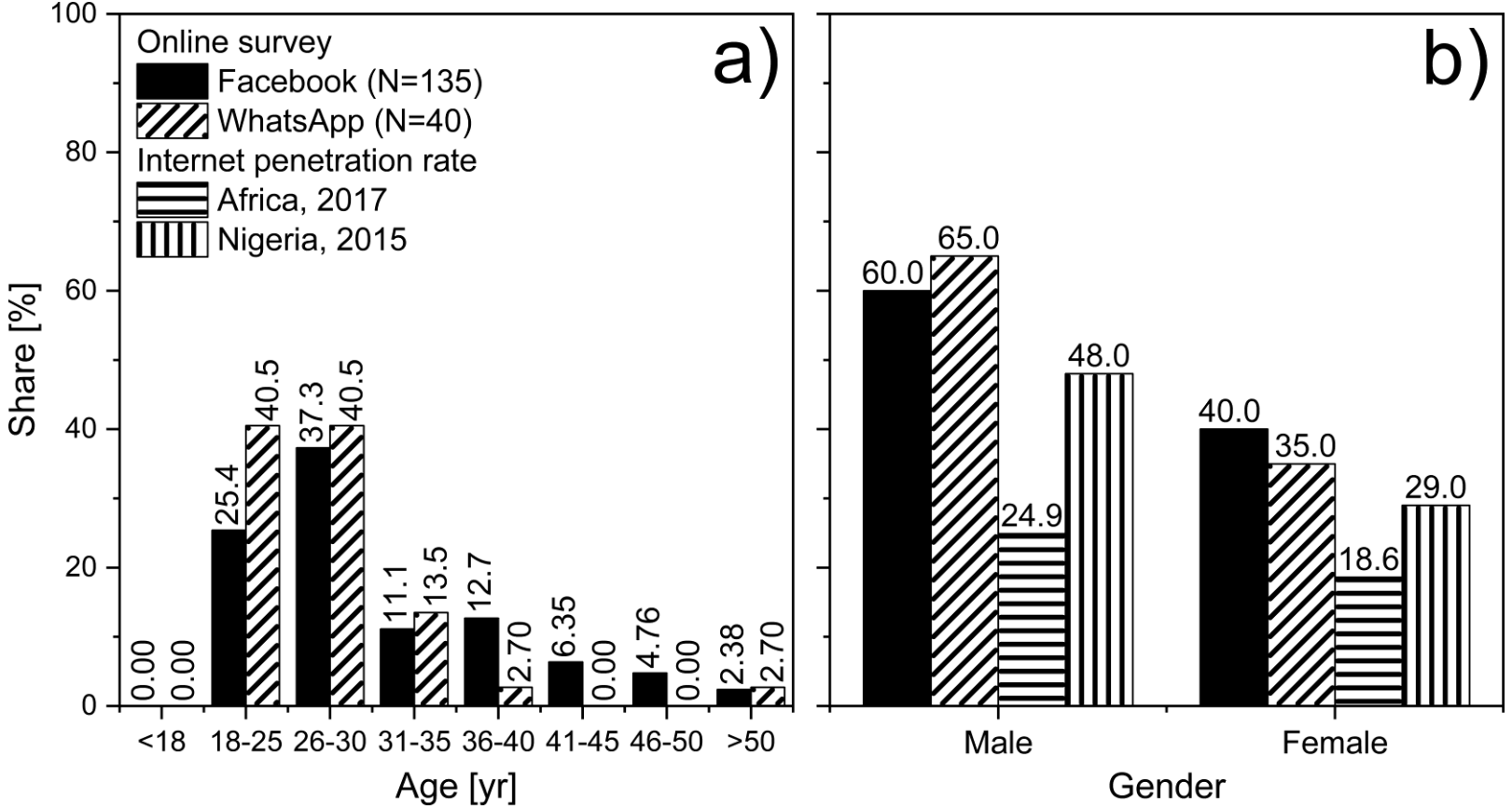
- [1] Parkinson, J., Lüthi, C., Walther, D. (2013). Sanitation 21: A Planning Framework for Improving City-wide Sanitation Services. Published by IWA.
- [2] https://edition.cnn.com/2012/10/04/tech/mobile/africa-mobile-opinion/index.html, accessed 09.08.2018.
- [3] https://www.bugbog.com/maps/africa/, accessed 01.08.2018.
- [4] https://de.wikipedia.org/wiki/Malawi, accessed 01.08.2018.
- [5] Morse, T. (2018) Personal communication: Cost of household interviews in Malawi with conventional field interviewers. Blantyre.
- [6] Strande, L., Schoebitz, L., Bischoff, F., Ddiba, D., Okello, F., Englund, M., Ward, B.J. and Niwagaba, C. (2018) Methods to Reliably Estimate Faecal Sludge Quantities and Qualities for the Design of Treatment Technologies and Management Solutions. Journal of Environmental Management (223), 898-907.
- [7] ITU (2017) ICT trends in the LDCs. https://www.itu.int/en/ITU-D/LDCs/Pages/ICT-Facts-and-Figures-2017.aspx, accessed 10.07.18.

Back-up – Incentive Schemes

- **Monetary incentives** clearly more effective than social messaging



Back-up Slides



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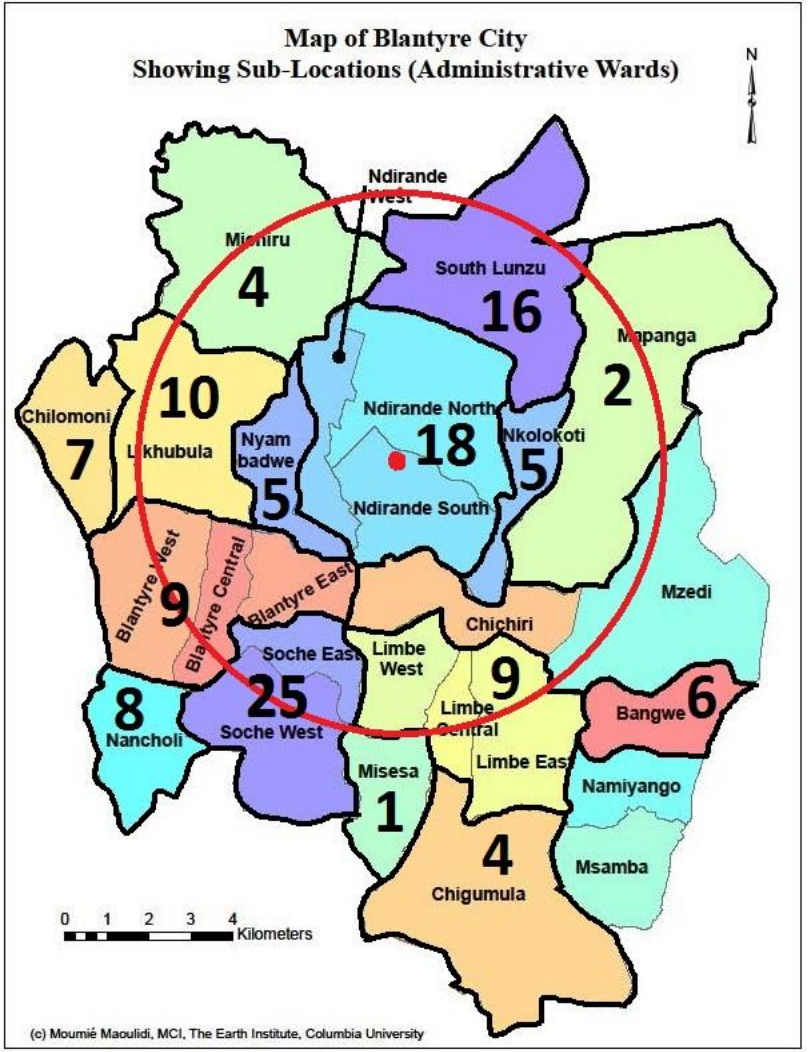

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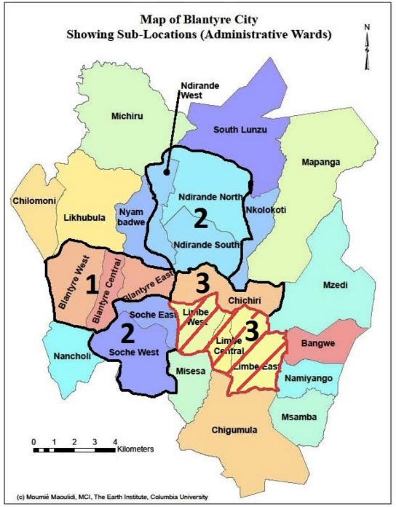
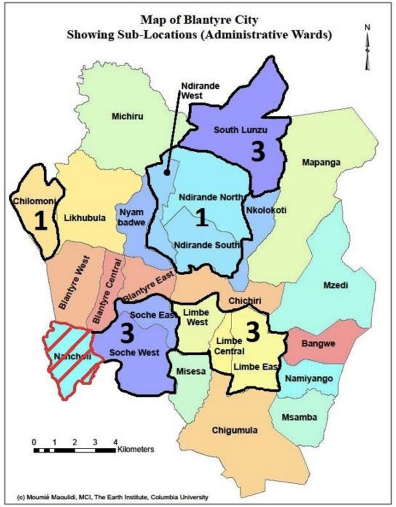
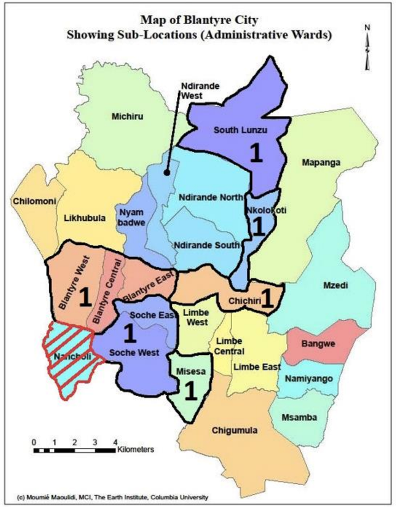
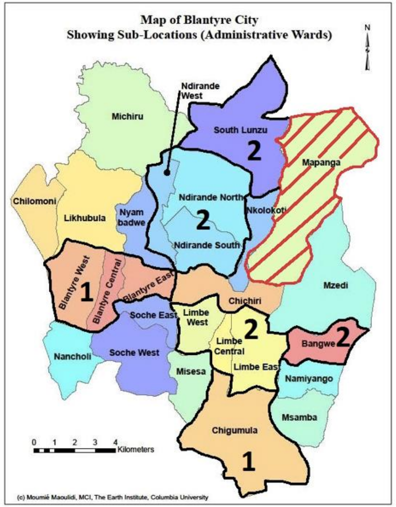








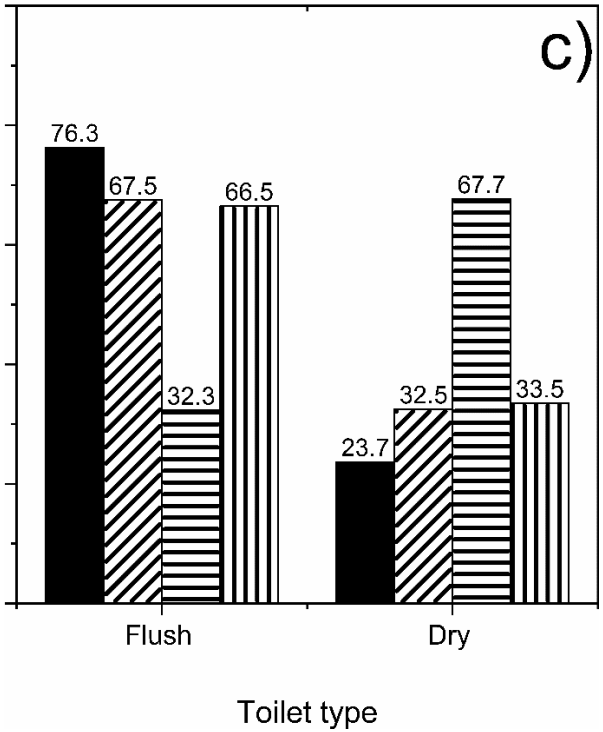
Back-up Slides

	Unit	N	Min	Max	Mean	Median	STD	Literature values
TS	g/L	40	0.44	157.3	40.3	11.0	52.1	Range of mean TS values: 9-52 g/L (Gold et al. 2017)
TSS	g/L	20	0.03	107.3	37.8	21.8	40.6	Range of SS values: 1.0-44.0 g/L (Koottatep et al. 2001)
VSS	g/L	40	0.02	58.5	14.1	6.0	16.2	Range of TVS values: 0.9-52.5 g/L (Koottatep et al. 2001)
COD	g/L	34	0.03	225.3	47.7	19.8	61.0	Range of mean COD values: 34.0-65.5 g/L (Gold et al. 2017)
SVI	mL/g	20	0.00	111.0	23.6	15.0	28.1	Range of SVI values: 40-80 mL/g (Heinss et al. 1999)

Back-up Slides

Variable 1 (independent)	Variable 2 (dependent)	Regression-coefficient	Value		p	
			with μ	with (μ+σ)	with μ	with (μ+σ)
TS	TSS	Intercept	1.96	4.19	0.715	0.543
		Slope	**0.62**	**0.55**	0.000	0.000
	VSS	Intercept	**1.65**	**1.51**	0.032	0.009
		Slope	**0.33**	**0.35**	0.000	0.000
	COD	Intercept	5.11	4.91	0.256	0.251
		Slope	**0.92**	**1.11**	0.000	0.000
TSS	VSS	Intercept	1.85	4.49	0.239	0.112
		Slope	**0.47**	**0.36**	0.000	0.000
	COD	Intercept	6.57	16.96	0.491	0.354
		Slope	**1.10**	**1.01**	0.000	0.001
VSS	COD	Intercept	3.80	2.59	0.407	0.653
		Slope	**2.45**	**3.04**	0.000	0.000

Back-up Slides



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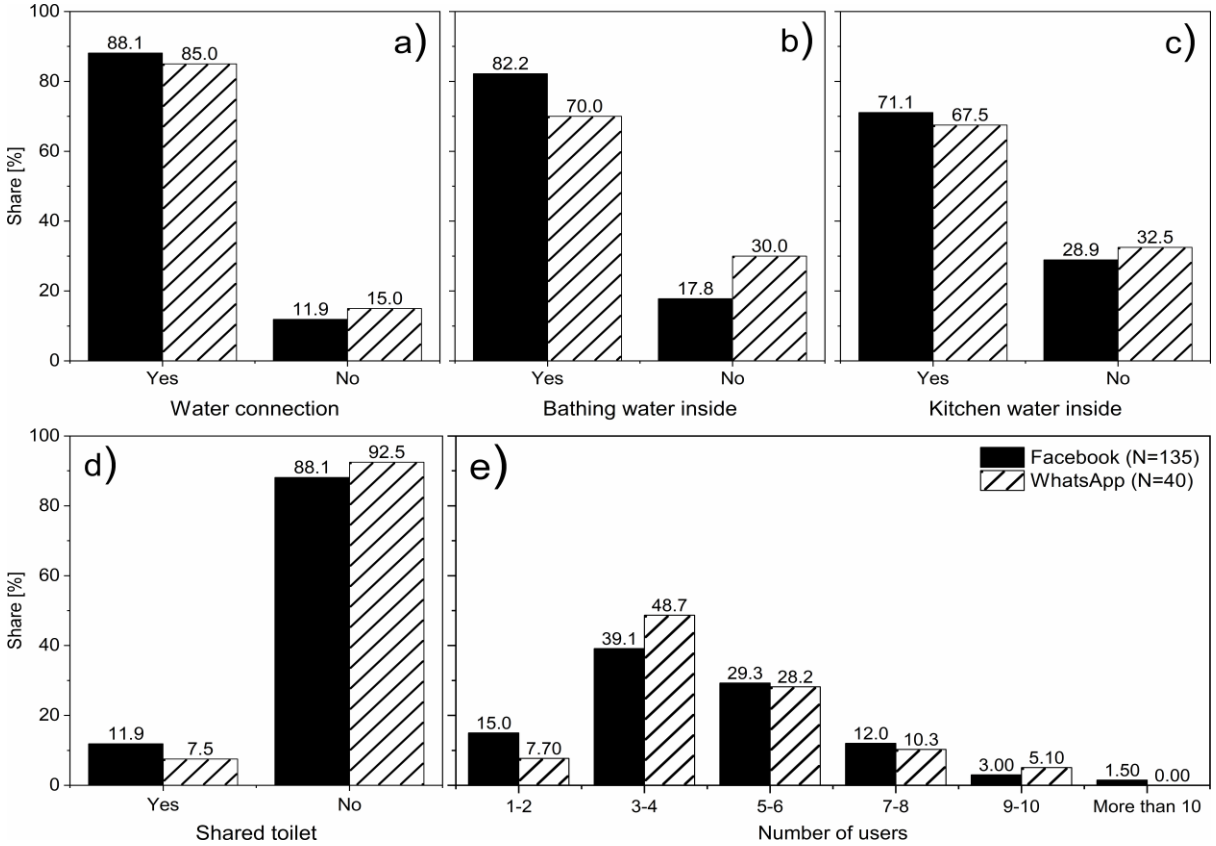

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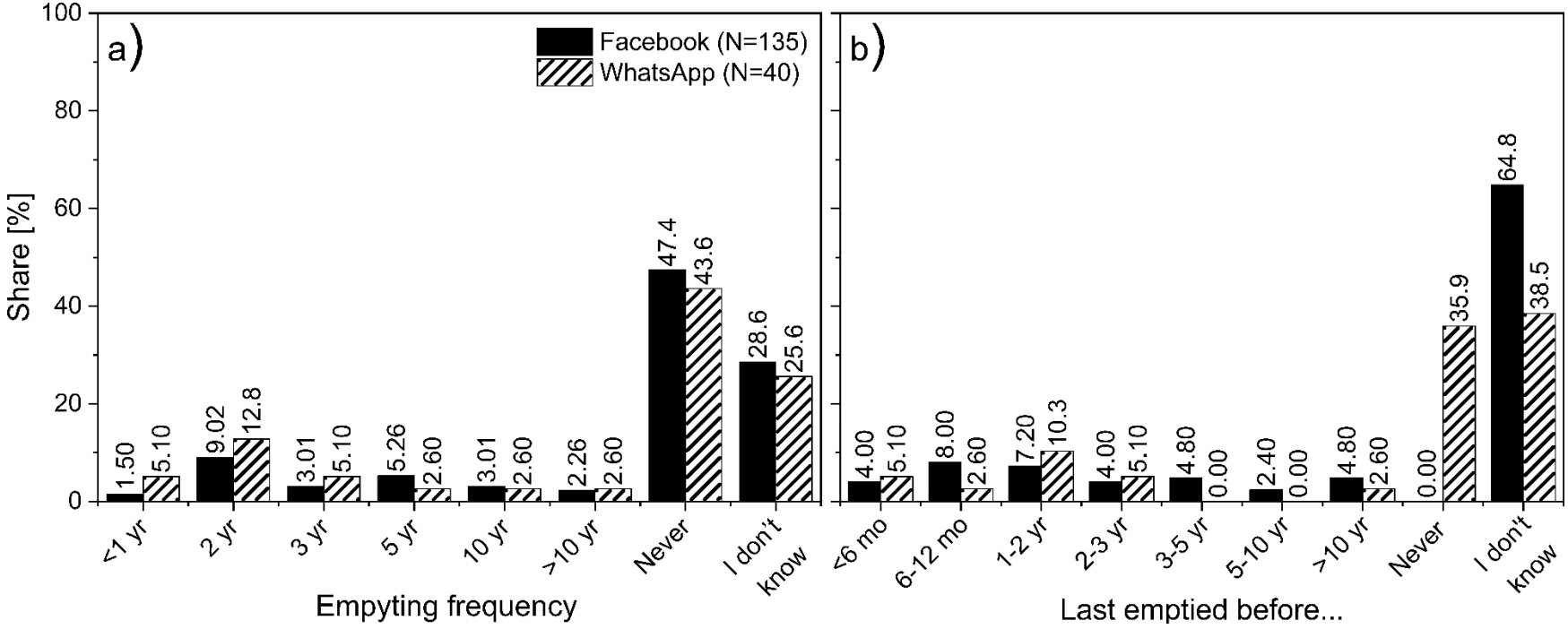

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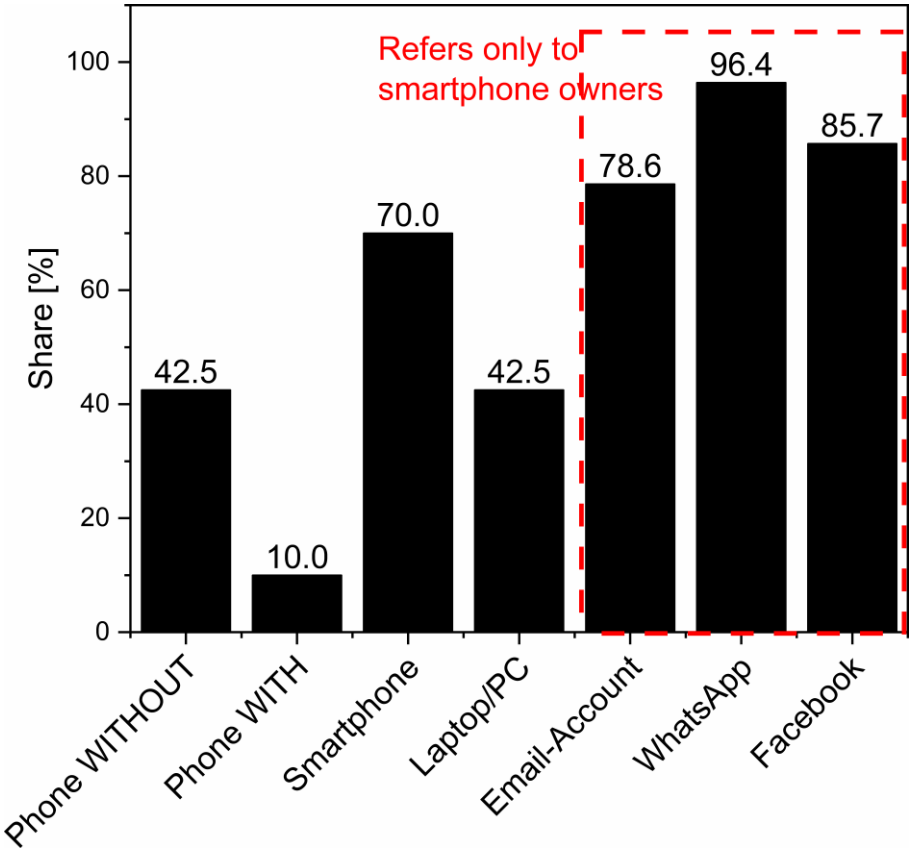

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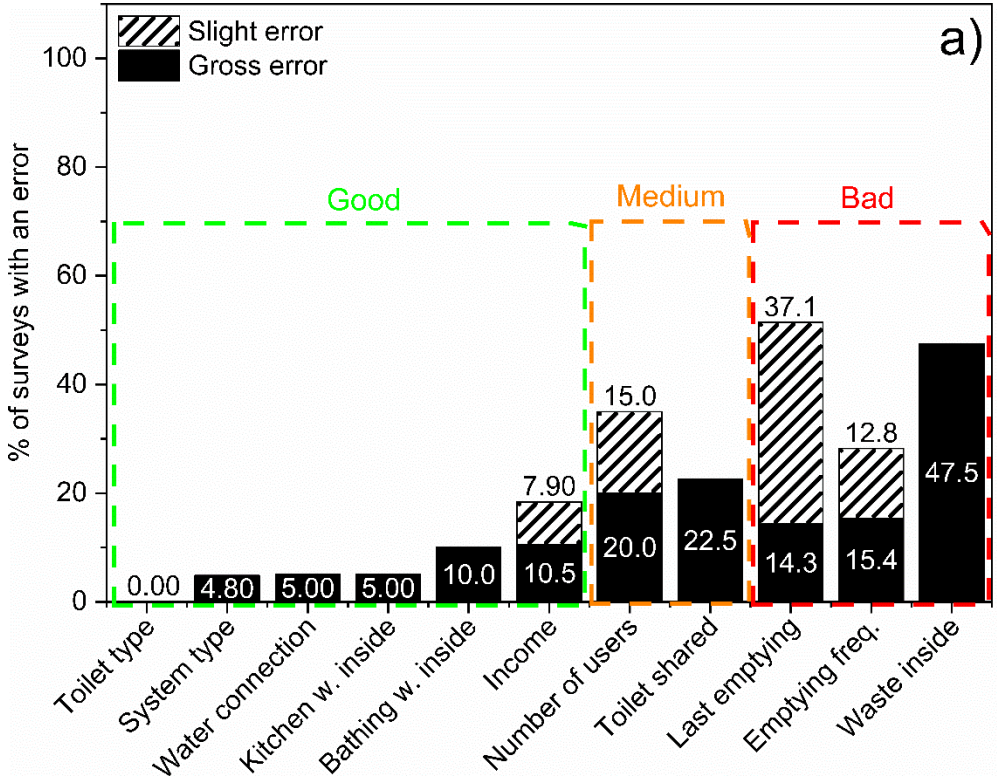

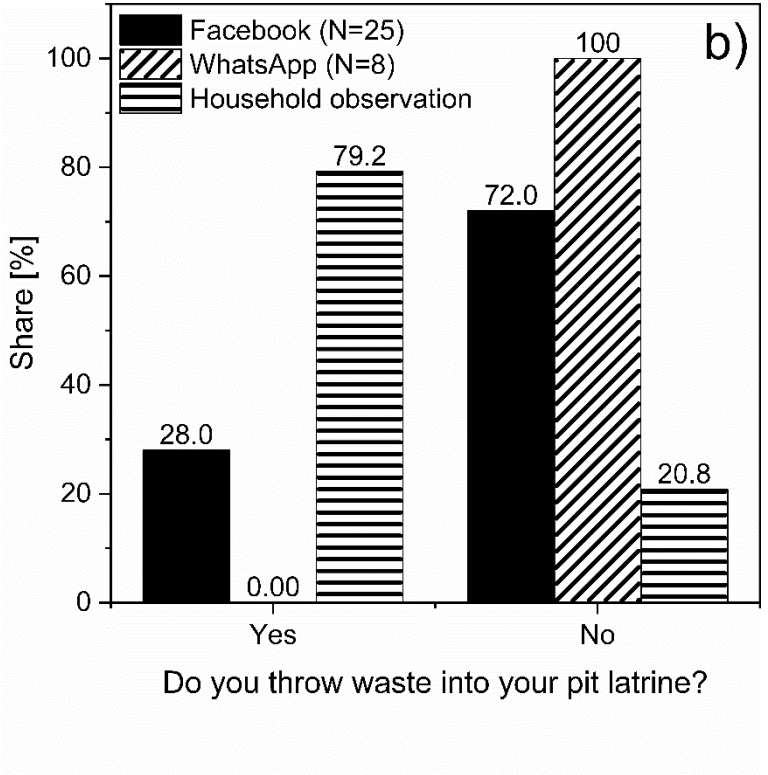

Back-up Slides

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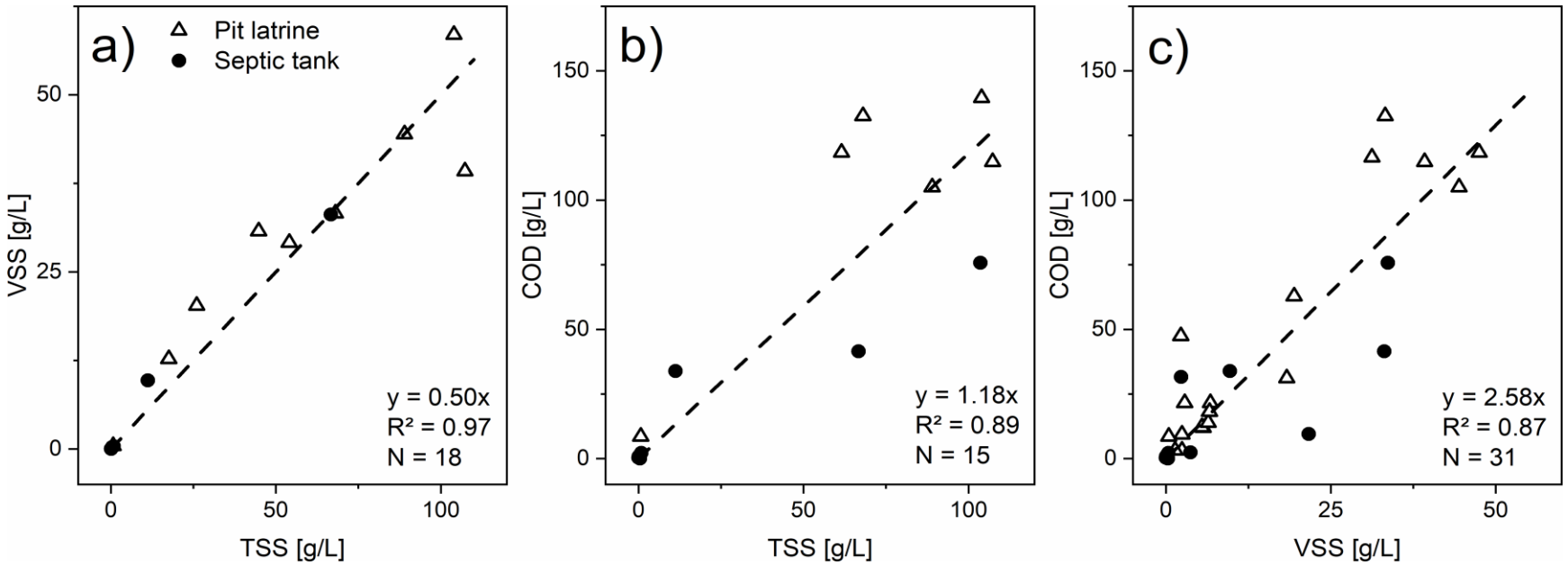

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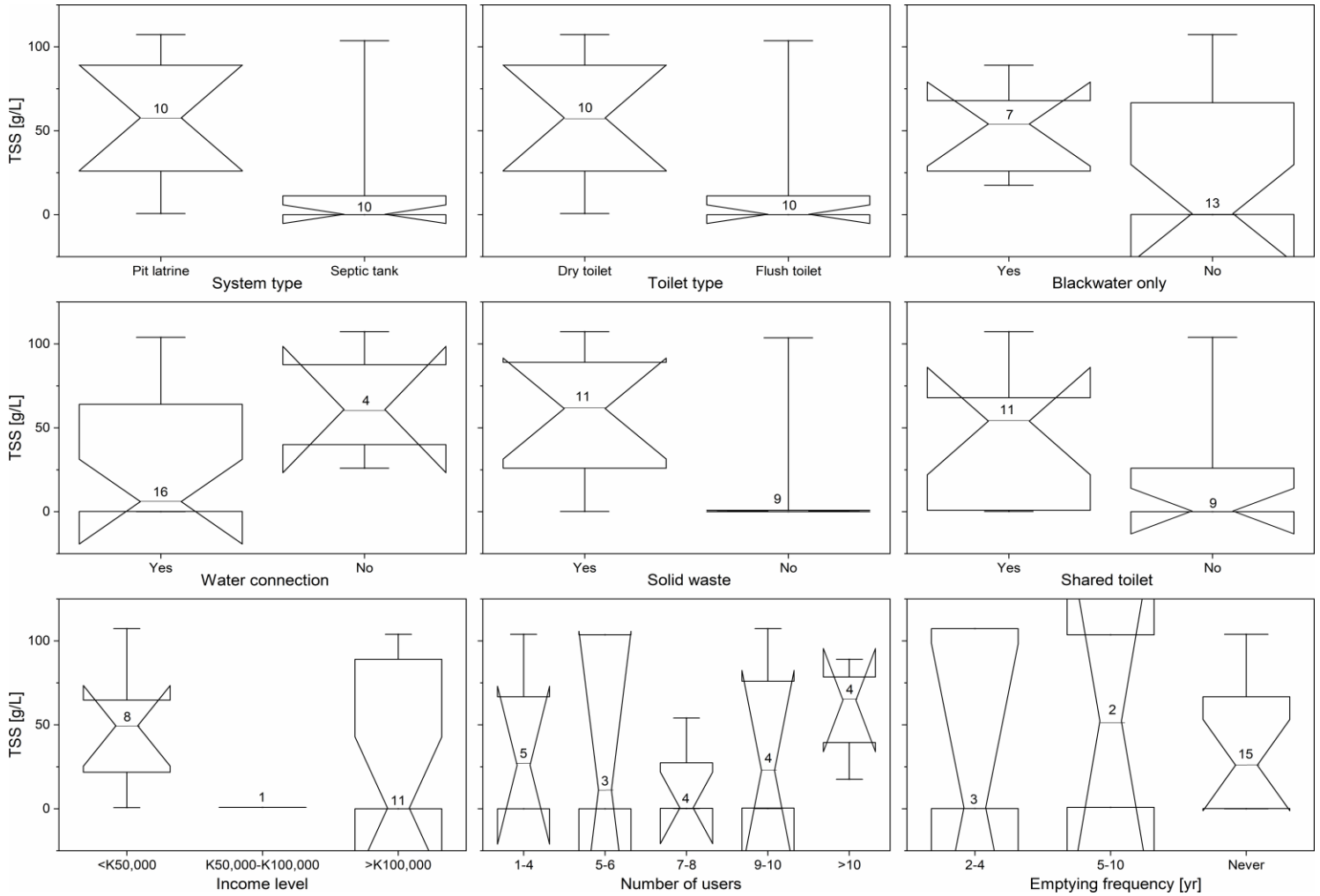
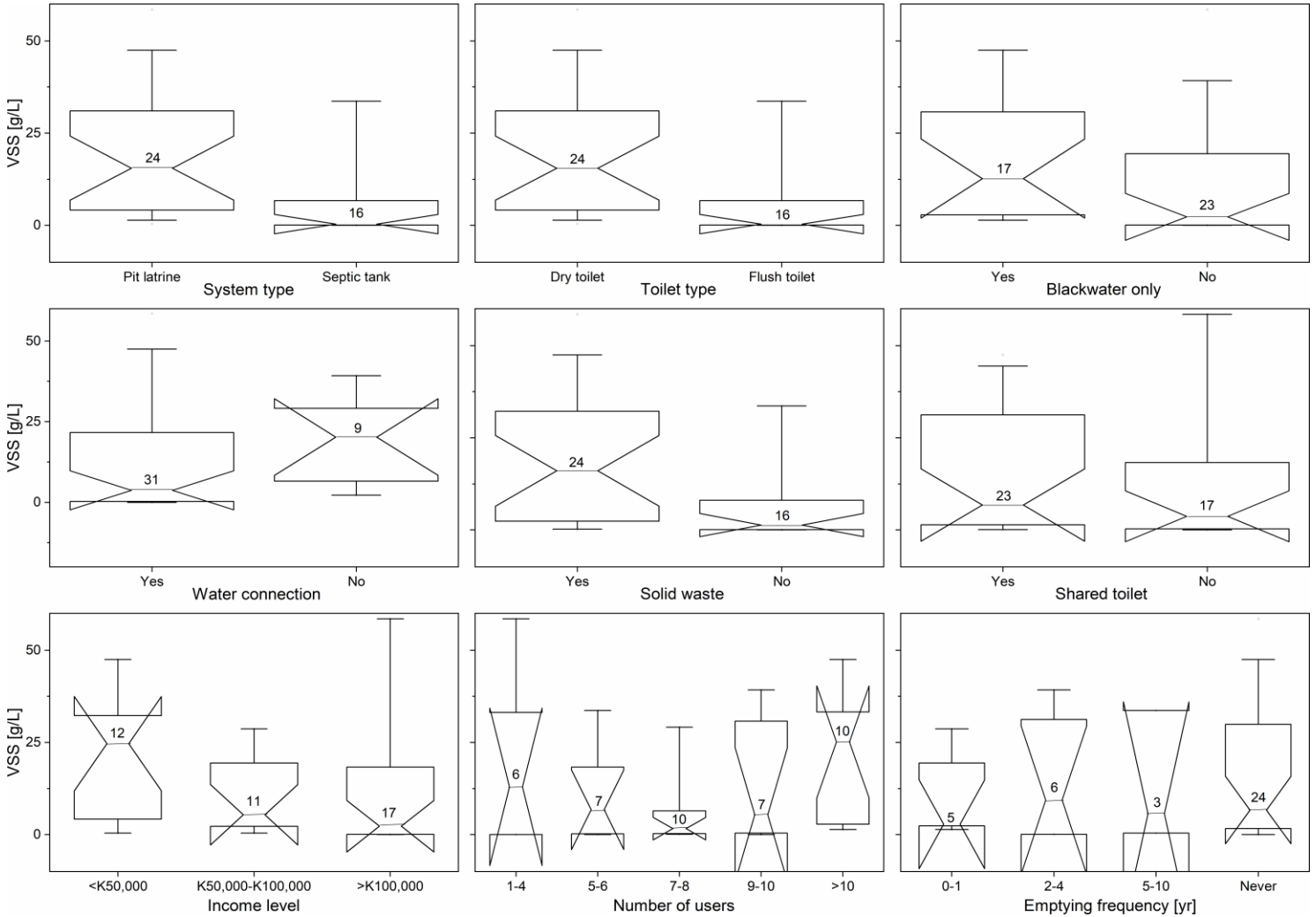
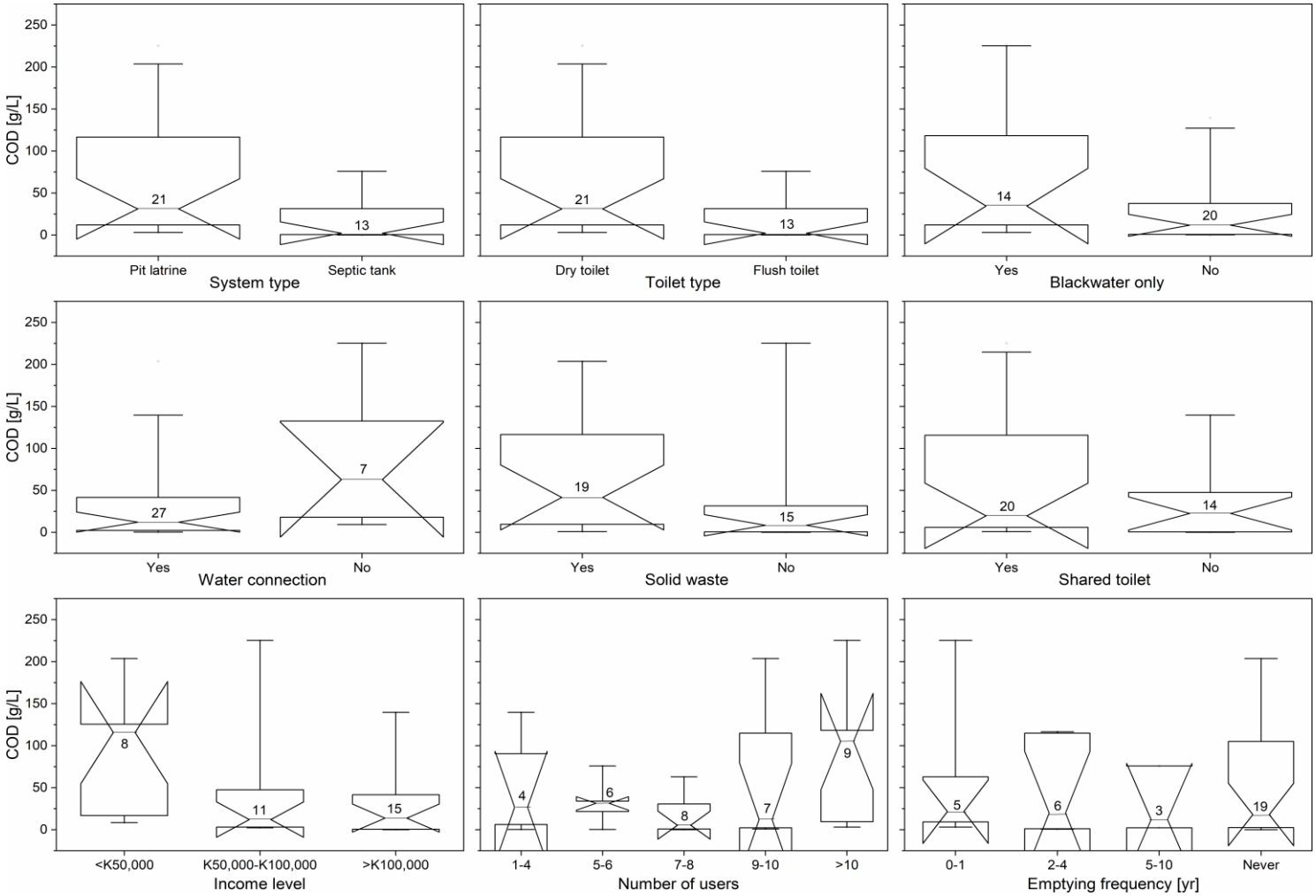

TSS [g/L]
100
50
0
10
10
Pit latrine
Septic tank
System type
10
10
Dry toilet
Flush toilet
Toilet type
7
13
Yes
No
Blackwater only
16
4
Yes
No
Water connection
11
9
Yes
No
Solid waste
11
9
Yes
No
Shared toilet
8
1
11
<K50,000
K50,000-K100,000
>K100,000
Income level
5
3
4
4
4
1-4
5-6
7-8
9-10
>10
Number of users
3
2
15
2-4
5-10
Never
Emptying frequency [yr]

Back-up

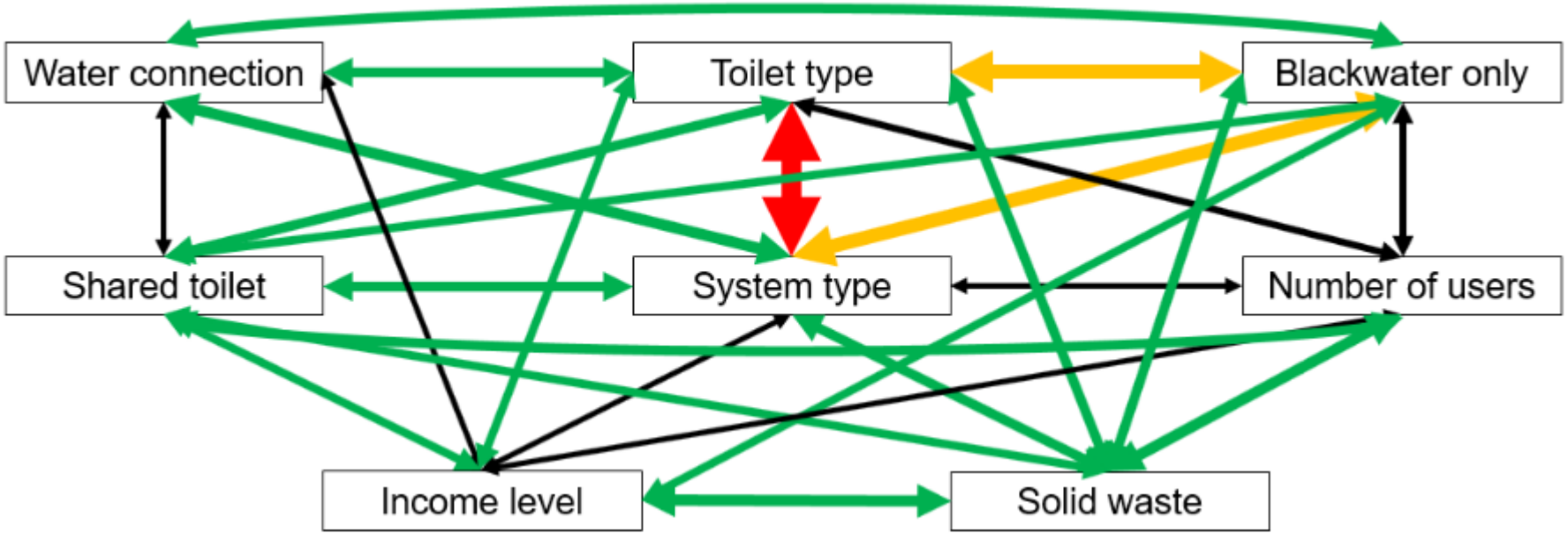

VSS [g/L]
50
25
0
24
16
Pit latrine
Septic tank
System type
24
16
Dry toilet
Flush toilet
Toilet type
17
23
Yes
No
Blackwater only
31
9
Yes
No
Water connection
24
16
Yes
No
Solid waste
23
17
Yes
No
Shared toilet
12
11
17
<K50,000
K50,000-K100,000
>K100,000
Income level
6
7
10
7
10
1-4
5-6
7-8
9-10
>10
Number of users
5
6
3
24
0-1
2-4
5-10
Never
Emptying frequency [yr]

Back-up


COD [g/L]
250
200
150
100
50
0
21
13
Pit latrine
Septic tank
System type
21
13
Dry toilet
Flush toilet
Toilet type
14
20
Yes
No
Blackwater only
27
7
Yes
No
Water connection
19
15
Yes
No
Solid waste
20
14
Yes
No
Shared toilet
8
11
15
<K50,000
K50,000-K100,000
>K100,000
Income level
4
6
8
7
9
1-4
5-6
7-8
9-10
>10
Number of users
5
6
3
19
0-1
2-4
5-10
Never
Emptying frequency [yr]

Back-up Slides

Color	Cramer's V
	0.2-0.4
	0.4-0.6
	0.6-0.8
	0.8-1.0



Back-up Slides – Uncertainty Analysis

Parameter	% of samples with coefficient of variation = σ/μ > 10%
TS	10
TSS	45
VSS	20
COD	65