Groundwater self-supply safety and associated risk factors for faecal contamination in urban Indonesia

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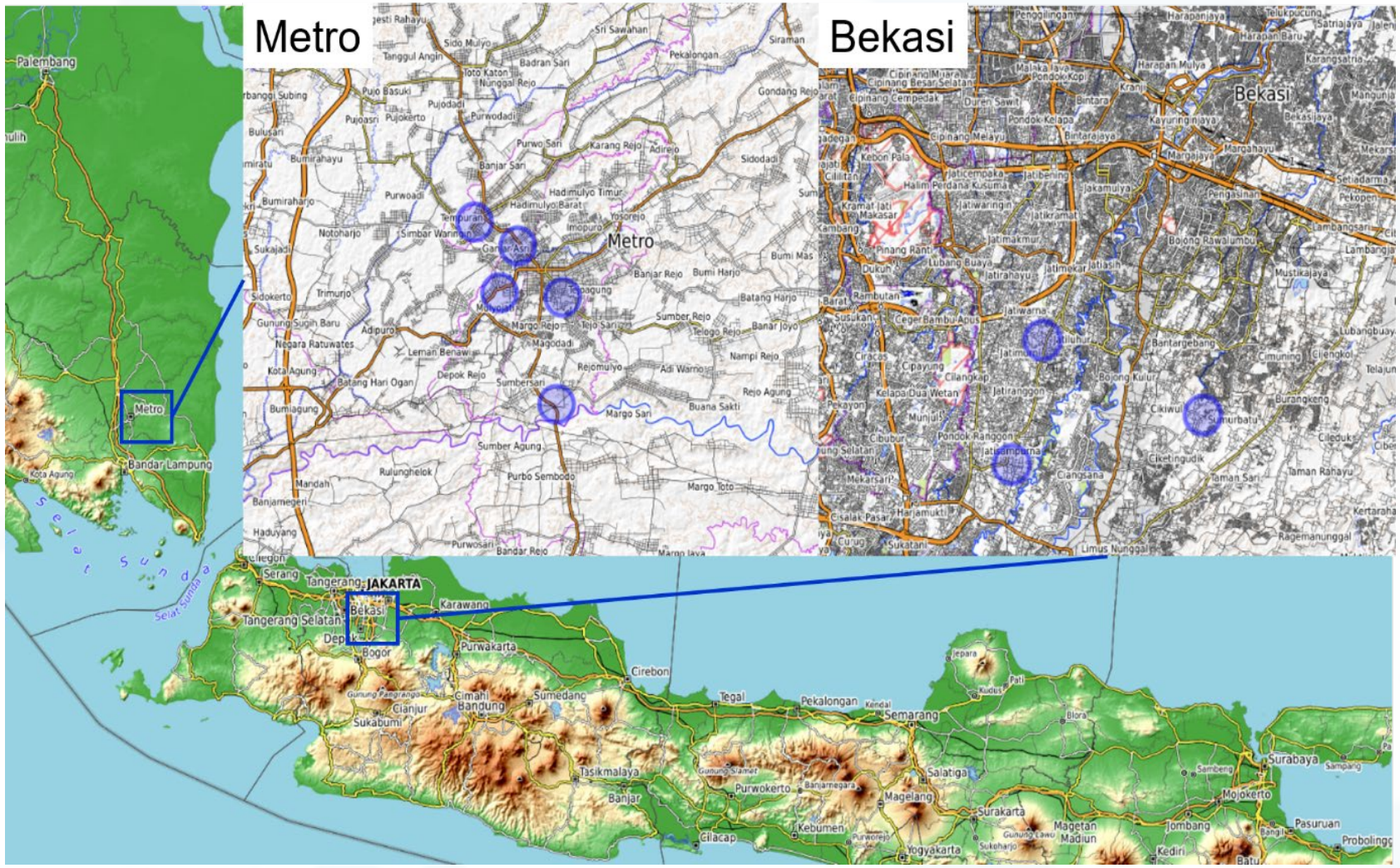
Self-supply

- Owned, invested, managed by household
- On-premises
- 41 million people in urban Indonesia

Safely-managed?
Accessible on-premises, but free from contamination?

- To what extent is groundwater self-supply free from faecal contamination?
- What are risk factors of faecal contamination in self-supply at source and point-of-use?

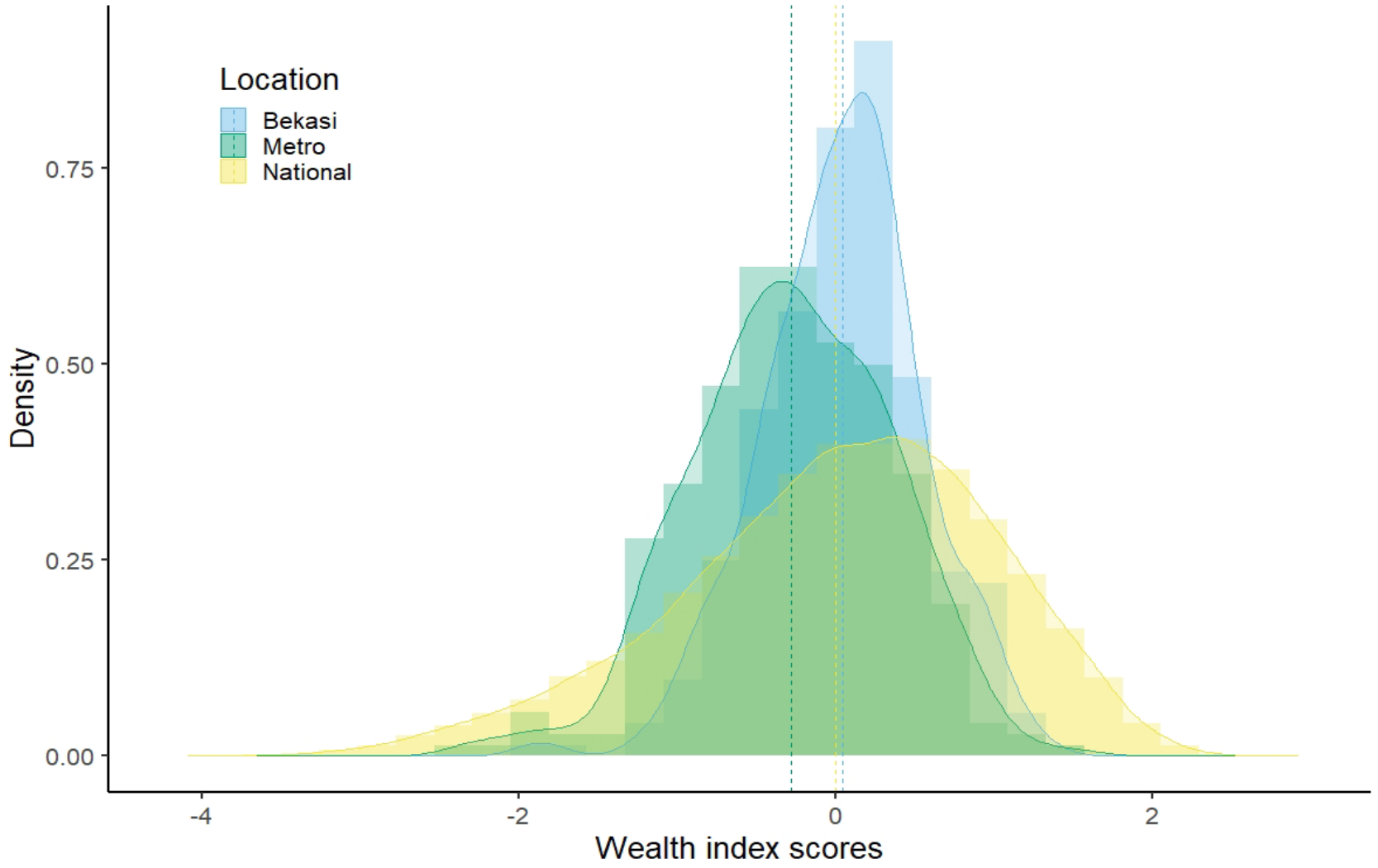
Study area



Bekasi
- Jatirangga
- Jatiluhur
- Sumur Batu

Metro
- Hadimulyo Barat
- Rejomulyo
- Iringmulyo
- Ganjarasri
- Karangrejo

Wealth distribution



Data collection

Household survey and sanitary inspection

- 300 households in Bekasi and Metro

Water quality

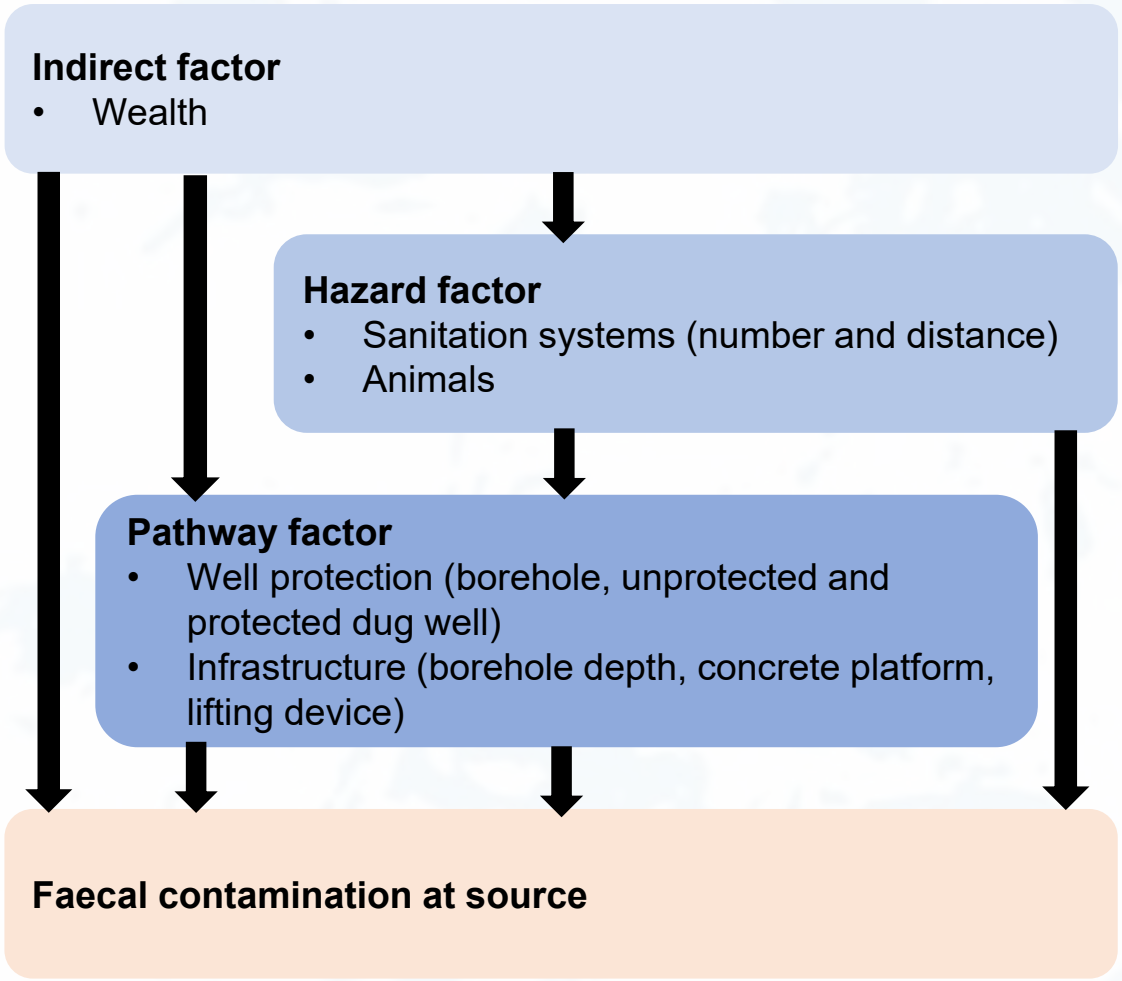
	Water samples	Self-supply sources	Point-of-use samples
Bekasi	n=240	n=222	n=79
Metro	n=296	n=271	n=92

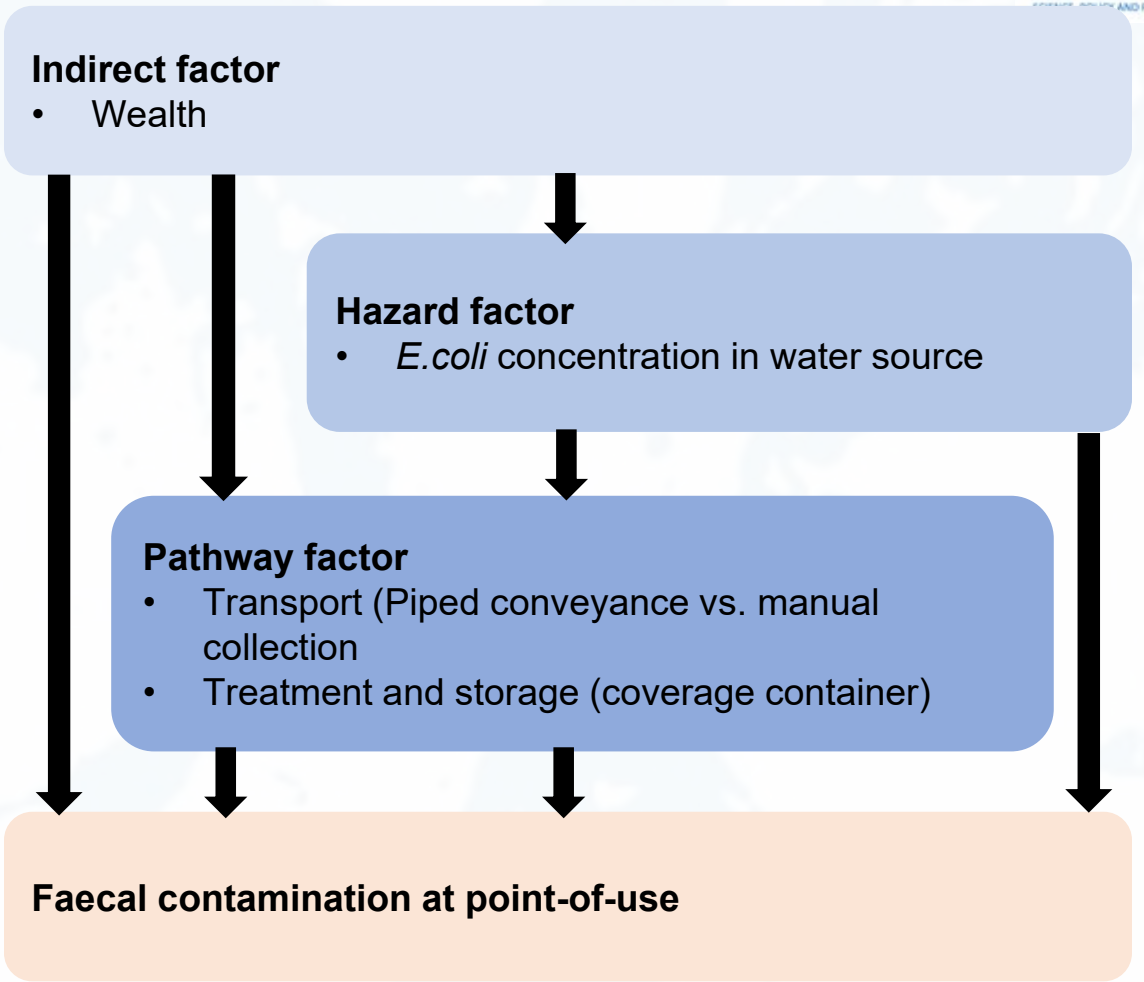
- Faecal indicator bacteria *Escherichia coli (E.coli)*
- IDEXX Colilert-18 and Quanti-Tray/2000 system

Season

- Bekasi: Feb-Mar 2020, wet season
- Metro: Oct-Nov 2020, dry season

Predictors of faecal contamination





Adapted from Cronin et al. 2017

Improved water quality at point-of-use

***E.coli* presence >1 MPN**

Bekasi

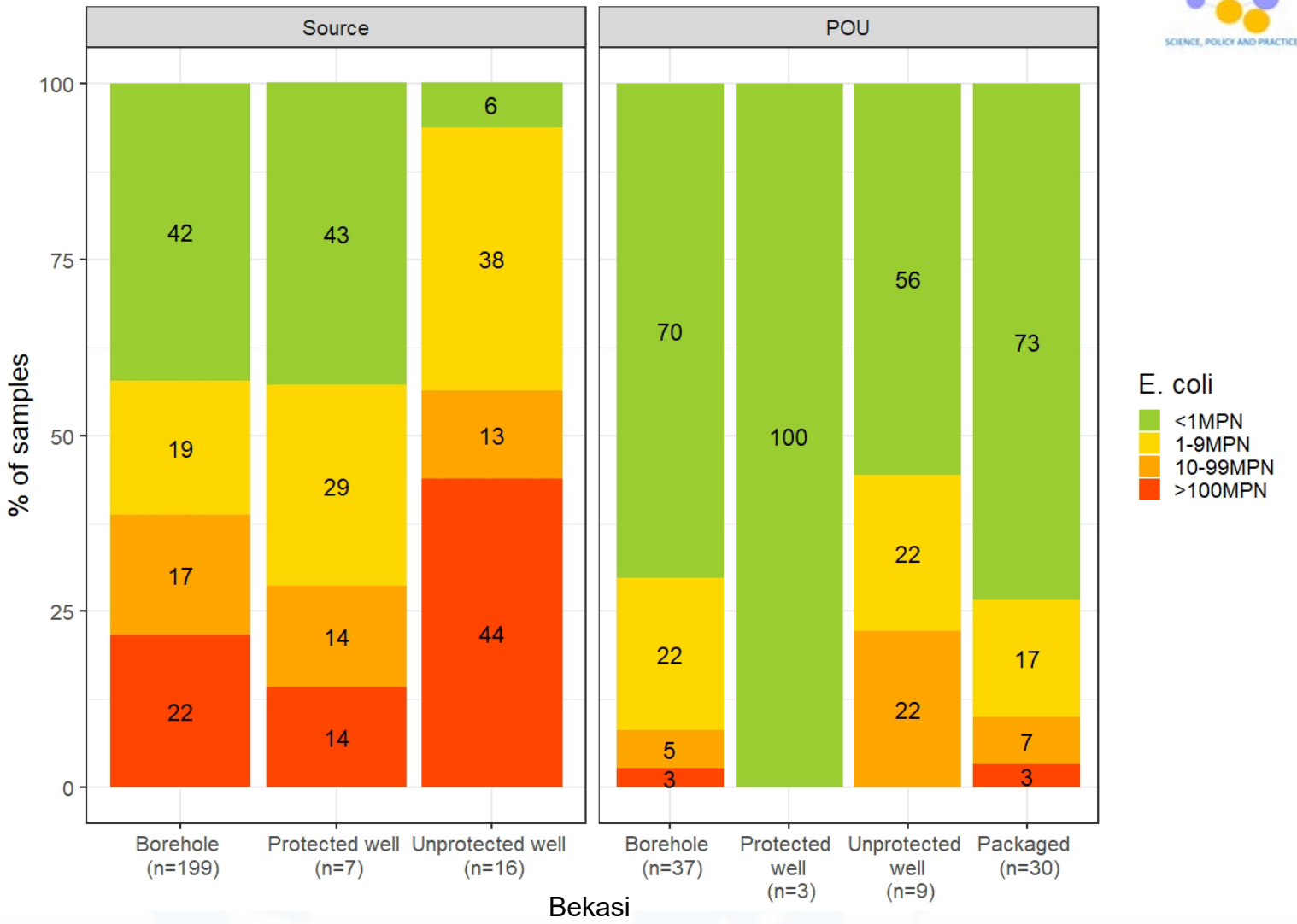
- Source: 60% (n=134/222)
- POU: 29% (n=23/79)

Paired samples Wilcoxon: p<0.001

Metro

- Source: 72% (n=195/271)
- POU: 32% (n=29/92)

Paired samples Wilcoxon: p<0.001



Water quality varies by wealth

Wealth and water quality

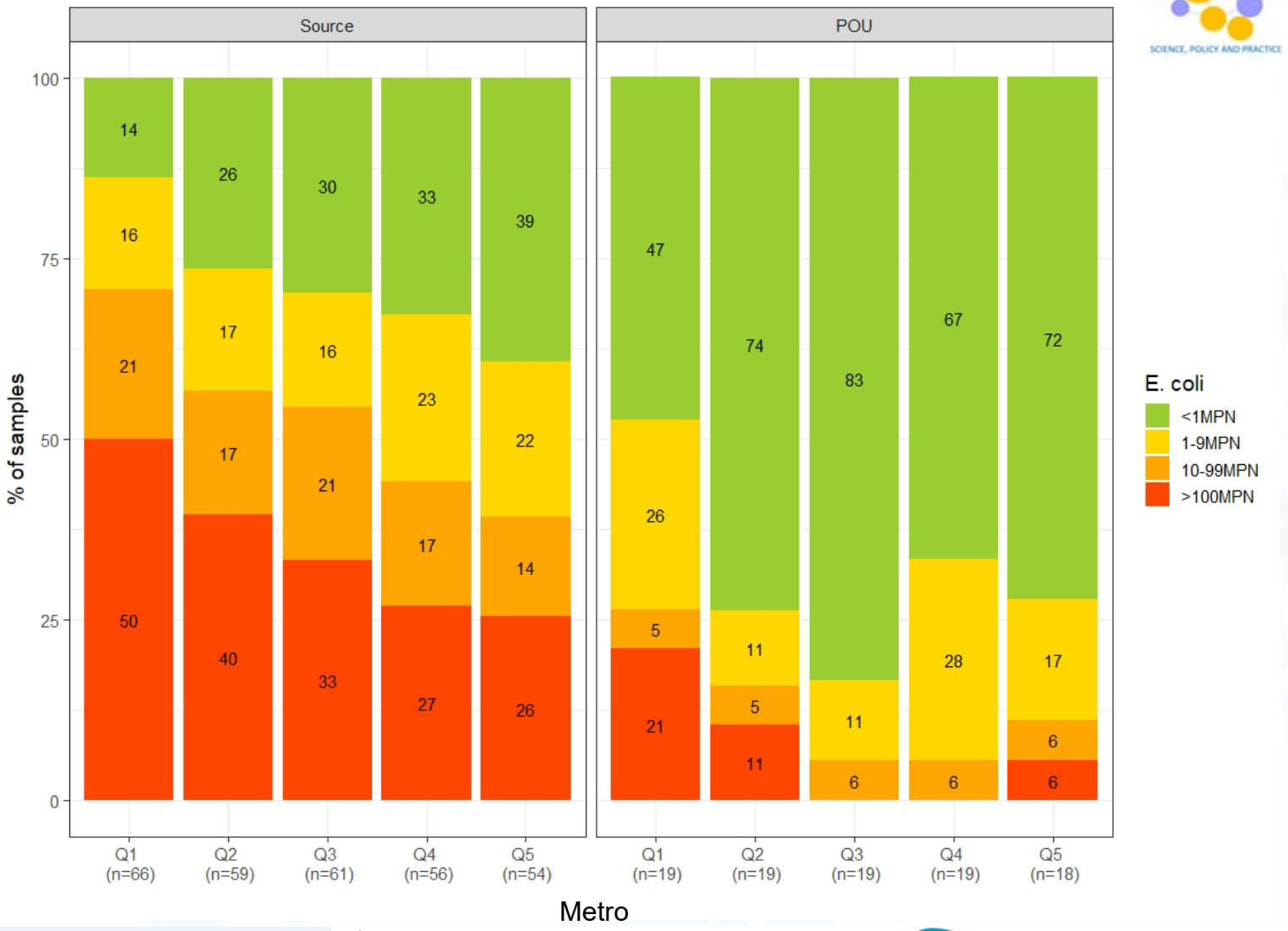
Spearman's rank

Bekasi

- Source: rho=0.025, p=0.704
- POU: rho=-0.150, p=0.150

Metro

- **Source: rho=-0.240, p<0.001**
- POU: rho=-0.150, p=0.150



Univariate analysis: Significant risk factors

	Source			Point-of-use		
Bekasi	**Risk factor**	**OR [95% CI]**	**p-value**	**Risk factor**	**OR [95% CI]**	**p-value**
>1 MPN	Well type	10.96 [2.16-200.05]	0.022	Source quality	1.02 [1.01-1.05]	0.035
>100 MPN	Well type Borehole depth	2.82 [0.96-8.01] 0.95 [0.90-1.00]	0.051 0.044			
Metro						
>1 MPN	Well type Wealth Lifting device	4.08 [2.27-7.41] 0.25 [0.09-0.61] 3.88 [1.25-17.10]	<0.001 0.003 0.036			
>100 MPN	Well type Wealth Lifting device	5.62 [2.76-12.72] 0.34 [0.15-0.76] 2.27 [1.08-4.85]	<0.001 0.010 0.032			

Multivariate analysis: Significant risk factors

	Source							Point-of-use		
	All self-supply			Boreholes			Dug wells			
Bekasi	**Risk factor**	**OR [95% CI]**	**p-value**	**Risk factor**	**OR [95% CI]**	**p-value**		**Risk factor**	**OR [95% CI]**	**p-value**
>1 MPN	Well type	12.37 [2.40-227.21]	0.016					Source quality	1.02 [1.01-1.05]	0.032
>100 MPN	Well type	3.16 [1.06-9.21]	0.034	Depth	0.94 [0.89-0.99]	0.026				
Metro										
>1 MPN	Well type	3.64 [1.96-6.80]	<0.001							
>100 MPN	Well type Wealth	5.00 [2.38-11.60] 0.52 [0.29-0.91]	<0.001 0.024	Wealth Platform	0.03 [0.00-0.40] 0.04 [0.00-0.57]	0.021 0.049				

Conclusion

Self-supply water quality:

- Faecal contamination of self-supply sources
- Widespread boiling practice improves water quality at point-of-use

Predictors of faecal contamination:

- Source water: Wealth, source type, borehole depth, water lifting device, concrete platform
- Point-of-use: Source water quality

Implications:

- Financial support to invest in better self-supply infrastructure
- Education about water quality, proper water treatment and storage
- Monitoring of self-supply water quality at source and point-of-use
- Role of self-supply vs. municipal piped systems

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