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Introduction

Siem Reap is a fast-growing city in northwest Cambodia that attracts over 2 million tourists per year.¹ 30.9% of Siem Reap’s population are in the lowest wealth quintile, with many living in informal settlements scattered throughout the city.¹ Sanitation infrastructure is poor or non-existent in informal settlements, putting residents at risk of exposure to fecal contamination and enteric pathogens. The SaniPath Tool assesses exposure to fecal contamination in low-resource urban settings to guide sanitation intervention strategies. The SaniPath team and local collaborators were interested in using the SaniPath Tool to assess how exposure to fecal contamination varied within and between informal and formal settlements of Siem Reap.

Methods

The SaniPath assessment was conducted in 5 neighborhoods of Siem Reap, including 2 informal settlements and 3 formal (tenured) neighborhoods. Data collection occurred from August to October 2016 and included: 410 household surveys to understand frequency of behaviors associated with exposure to pathways, and 243 environmental samples to quantify *E. coli* concentration in the environment. *Table 1* shows data collected from each study neighborhood. Behavior and environmental data were combined and analyzed using Bayesian method and Monte Carlo simulations to develop risk profiles. The risk profiles illustrate the estimated percentage of the neighborhood population that is exposed to fecal contamination from a particular pathway and the mean dose of exposure (average amount of *E. coli* ingested per month).

Table 1: Sample sizes for data collected in 5 neighborhoods in Siem Reap

Neighborhood Name	Behavioral Surveys	Number of Environmental Samples Analyzed					
		Raw Produce	Flood Water	Ice†	Drinking Water		
					Bottled Water	Well Water	Municipal Water
Chong Koasou (Informal)	45	10	10	10	10	10	0
Kumruthemey (Informal)	66	13*	10	10	10	10	0
Kumruthemey (Formal)	114		10	10	10	10	0
Veal/Trapangsyes (Formal)	99		10	10	10	10	0
Steung Thumey (Formal)	86	10	10	10	10	10	10‡
Total	410	33	50	50	50	50	10

* The same 13 produce samples were used for Kumruthemey informal and formal areas and Veal/Trapangsyes, as all three neighborhoods shared the same produce markets

† Behavioral data was not collected on adult and child exposure to ice

‡ Of the study neighborhoods, only residents in Steung Thumey had access to municipal water

References:

1. National Institute of Statistics/Cambodia, Directorate General for Health/Cambodia, and ICF International. (2015). Cambodia Demographic and Health Survey 2014. Phnom Penh, Cambodia: National Institute of Statistics/Cambodia, Directorate General for Health/Cambodia, and ICF International.

Figure 1: Five study neighborhoods in Siem Reap, Cambodia

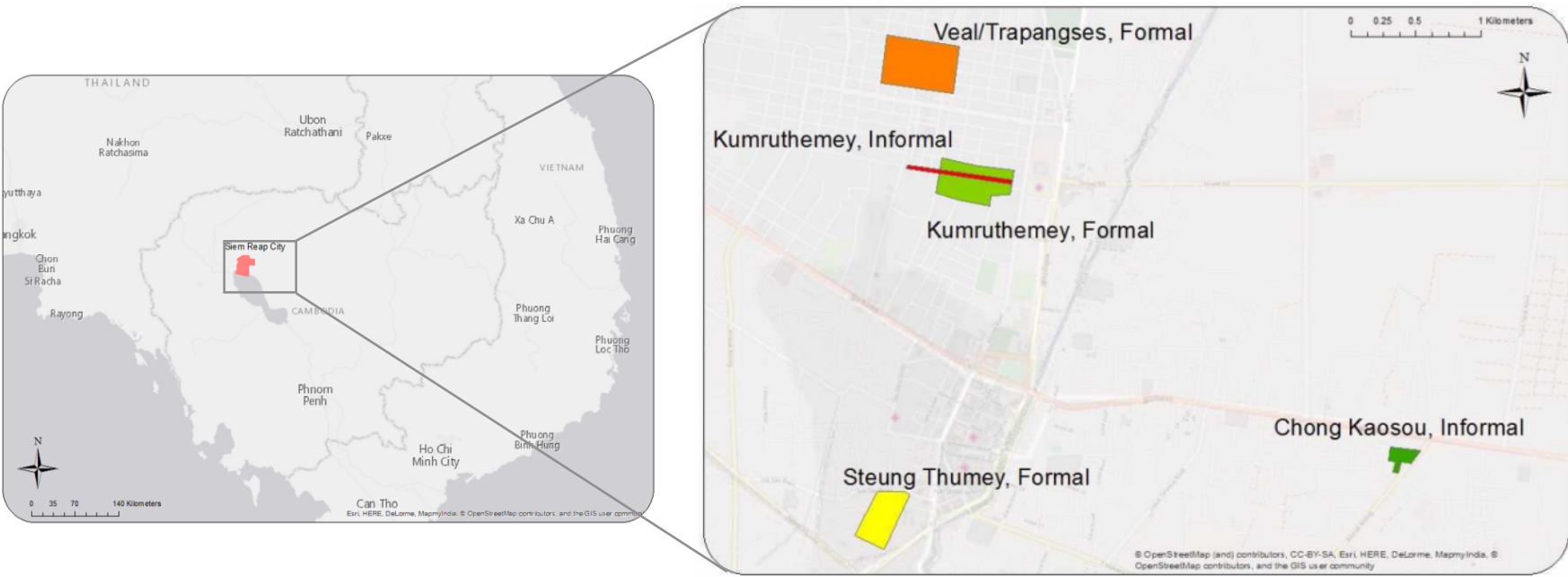
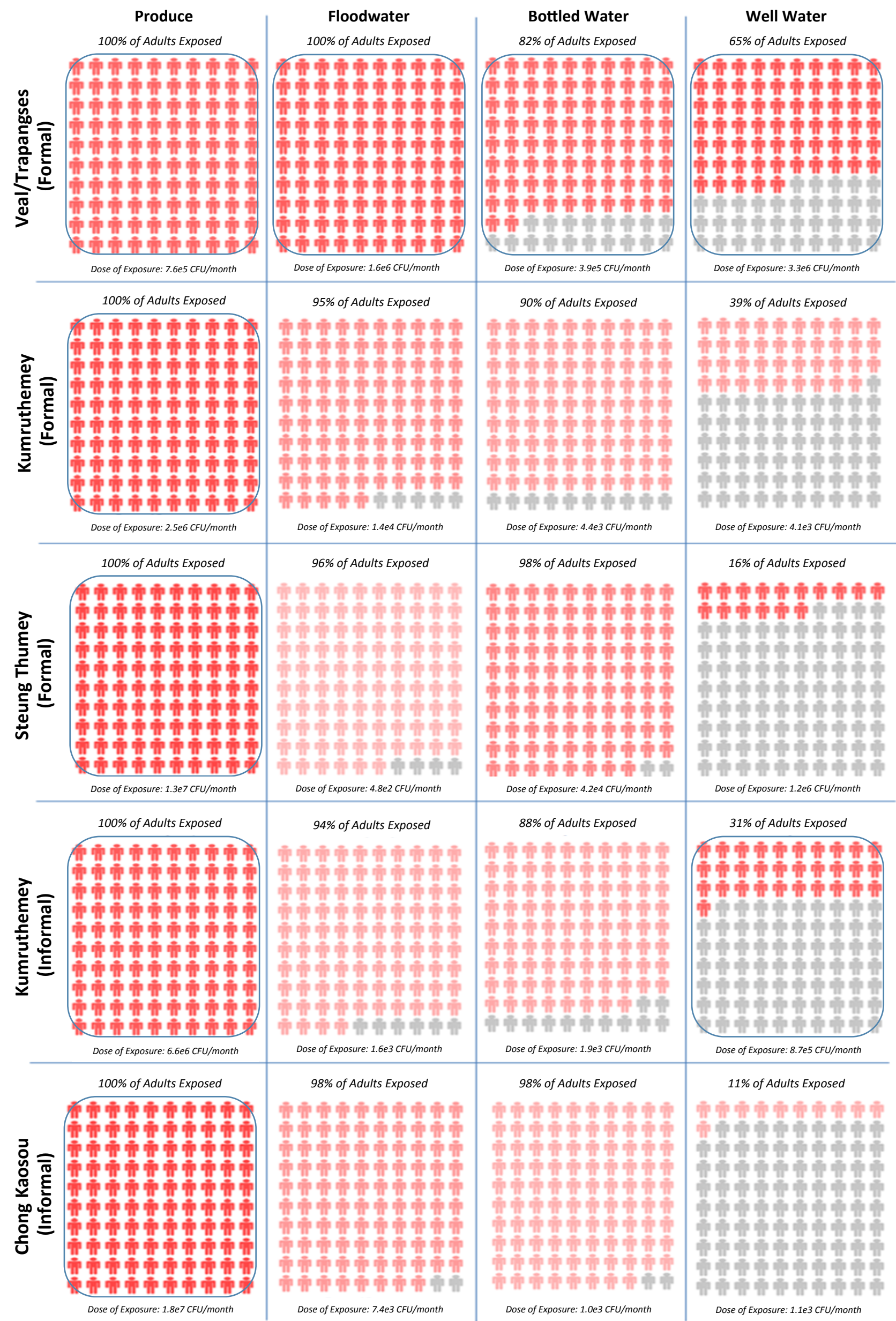


Figure 2: Risk profiles for adults for each pathway in all study neighborhoods; dominant exposure pathways, circled below, make the greatest contribution to total exposure to fecal contamination within each neighborhood.



Results

In all neighborhoods, produce was a dominant exposure pathway for both adults and children, with all survey respondents ingesting >10⁴ colony forming units (CFU) of *E. coli* per month. Bottled water was the primary drinking water source for most respondents in both formal and informal neighborhoods resulting in high levels of exposure to fecal contamination from this pathway (ranging from 10³ CFU to 10⁵ CFU of *E. coli* per month). Over 80% of adults and children reported contact with floodwater during the rainy season; floodwater was a dominant pathway for adults and children in Veal/Trapangsyes (formal) and for children in Kumruthemey (formal). Well water was reported as a source of drinking water for ≤ 65% of all respondents with highest frequency of exposure in Veal/Trapangsyes (formal). This study did not find land tenure status to have an impact on risk of exposure to fecal contamination.

Figures 3 & 4: Residents in Chong Koasou; Typical home in Siem Reap’s informal settlements
Photo credit: WaterAid Cambodia



Discussion

- **Raw produce** was a dominant pathway of exposure to fecal contamination in all study neighborhoods, regardless of land tenure status. Sanitation interventions and policy should prevent waste water use for irrigation and promote safe food preparation and hygienic food handling practices.
- The one neighborhood with a drainage system in the city center, Steung Thumey, had the lowest exposure to fecal contamination from **flood water** among all study neighborhoods. Interventions should focus on increasing and maintaining street drainage systems, especially in low-lying areas, to reduce contact with floodwater
- The main reported sources of **drinking water** for nearly all respondents was bottled water and well water - both of which were contaminated with *E. coli*. Samples of municipal water had very low *E. coli* contamination but none of the respondents reported using this as a source of drinking water. Increasing access to municipal water and promoting it as a safe source of drinking water may reduce exposure to fecal contamination from drinking water

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