Supporting Information

S.1. Methods

S.1.1. Microbial Contamination. *E. coli* contamination was measured on surfaces, in bulk materials, in water, and on hands.

S.1.1.1. Surfaces. To estimate microbial contamination on the surfaces of objects contacted, *E. coli* concentrations were measured in August-September 2016. For each of the object categories included in the simulation (Table 1), between 9 and 23 separate swab samples were collected. Surfaces ($100cm^2$) were sampled using sterile polyester-tipped swabs pre-wet in phosphate buffered saline (PBS). Swabs were eluted in 10 ml of PBS, and eluent was filtered onto 0.45 μm mixed cellulose esters membranes (Microfil V filtration device, Merck KGaA). *E. coli* were on Chromocult Coliform Agar cultivation (Merck KGaA, Darmstadt, Germany). The limit of detection of the assay was 5 CFU / $100cm^2$.

S.1.1.2. Bulk Materials and Water. *E. coli* contamination of bulk materials (ash, excreta, and mud) and water was determined. To measure *E. coli* in ash, ash was collected in sterile whirl-pak bags, kept on ice, and returned to the laboratory within 4 hours. Samples were tested by the pour plating method of 0.2 and 5.0 g samples using Chromocult Coliform Agar (Merck KGaA) (Niwagaba et al., 2009). The lower and upper detection limits were 0.2 and 5000 CFU / g, respectively. *E. coli* contamination of other bulk materials (drinking water, surface water, excreta, and mud) were based on our previous survey in September 2013-November 2014)(Kuroda, 2015). Drinking water, surface water, excreta, and mud were respectively sampled from drinking water stored within the home, irrigation water, and stored excreta in dry toilet fecal chambers, and paddy field mud. In brief, sterile 250 ml PP containers (for water and mud) and whirl-pak bags (for excreta) were filled, and the containers was kept on ice and returned to the laboratory within 4 hours. *E. coli* in drinking water were enumerated through membrane filtration of 200 ml samples followed by culturing on Chromocult Coliform Agar, according to manufacturer's instructions. The lower and upper detection limits of the assay were 50 and 4.5×10^5 CFU / 100 ml, respectively. For *e*xcreta, 10 g samples were mixed with 90 ml phosphate-buffered saline, and then ultrasonicated for 3 minutes for eluting *E. coli* into the liquid phase, according to a bacteria test method for compost (Soil Association of Japan, 2010). The liquid was tested in the similar manner to the above water sample.

S.1.1.3. Hands. Hand rinse samples were obtained to estimate *E. coli* contamination on hands both before and after the videotaped activity for 15 farmers: 6 who collected excreta from latrines, and 9 who applied excreta to fields. Immediately after starting to record, the first hand rinse sample was taken from a randomly chosen hand. After the activity was finished, a second hand rinse sample was collected from the same hand. Hand rinse samples were collected as previously described (Pickering et al., 2011). In brief, one hand was placed in a 1L Whirl-pak bag (Nasco, Fort Atkinson, WI, USA) containing 300 ml of reverse osmosis purified water. The

water bag was tied to the wrist, and the farmer was asked to rinse the hand gently in the water for 30 seconds. The hand was then removed, the bag sealed and stored on ice for transport for up to 6 hours. One field blank containing 300 ml of reverse osmosis purified water placed in a Whirl-pak bag and transported along with other samples was also processed every day of sampling.

E. coli were enumerated from hands using Compartment Bag Tests (Aquagenx, North Carolina, USA) according to manufacturer's instructions. Two volumes of the hand rinse water were assayed: 100 ml and 1 ml (diluted in 99 ml of reverse osmosis purified water) to represent 1:3 and 1:300 dilutions. Bags were incubated at 36C for 48 hours. Most Probable Number (MPN) was calculated from the results of both dilutions simultaneously using the freely available spreadsheet software described by Jarvis et al. (2010) (Jarvis et al., 2010). When *E. coli* was not detected in any compartment, contamination was assumed to be equal to the lower limit of detection (3 MPN *E. coli* per hand). In the small subset of samples (2/30, or 8%) in which *E. coli* was detected in all compartments of both dilutions, contamination was assumed to be equal to the upper limit of detection (30'000 MPN *E. coli* per hand).
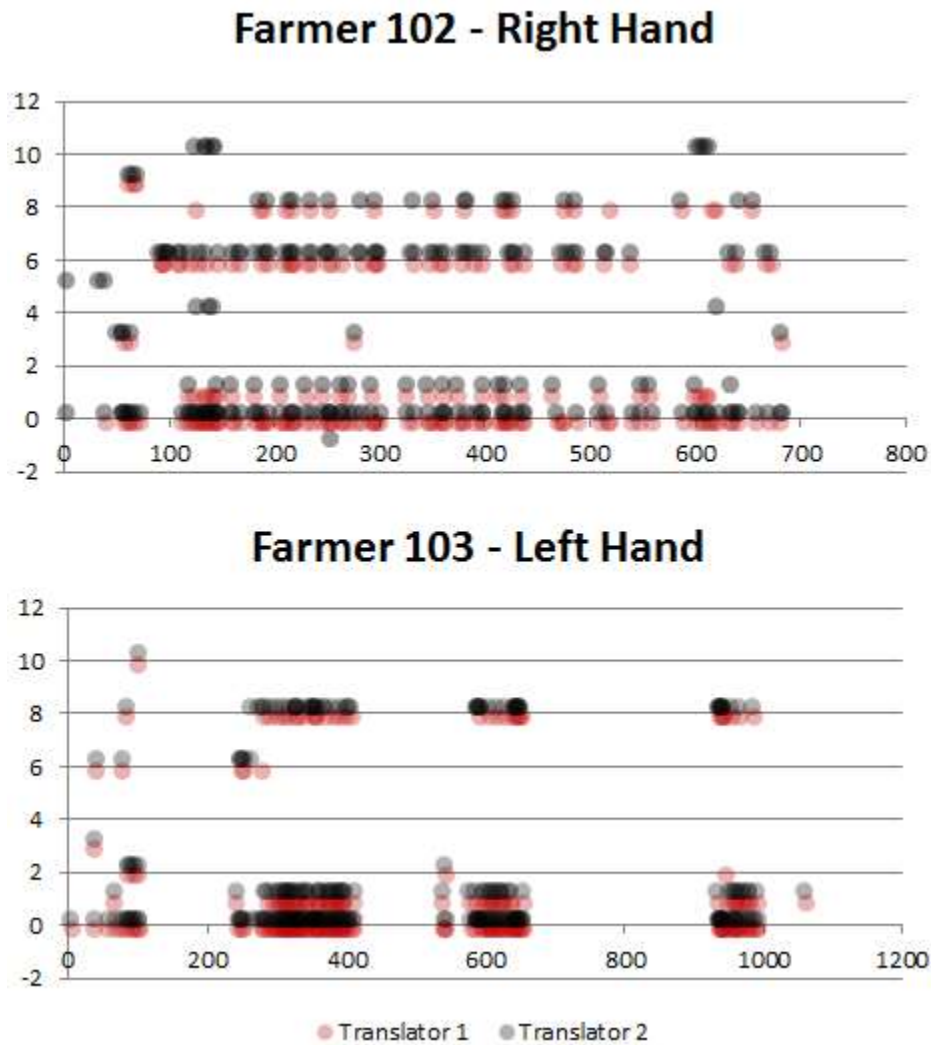
**S.2. Results**
S.2.1. Comparison of Translators

Farmer 102 - Right Hand

Farmer 103 - Left Hand

● Translator 1 ● Translator 2

Figure S1: Variation in translations as influenced by translator. The ordinate represents object category classification, with each number representing a unique object. The abscissa represents timing as measured in seconds.

Table S1: Variation in translations as influenced by translator. Variation is due to differences in both object classification as well as observed frequency of an individual contact event.

	Number of Contacts			Duration of Contacts (s)		
	Translator 1	Translator 2	Difference (%)	Translator 1	Translater 2	Difference (%)
Boots / Shoes	3	3	0%	10	11	-8%
Bucket (Plastic)	50	66	-28%	230	209	9%
Cloth	5	7	-33%	56	53	5%
Excreta	0	4	-200%	0	9	-200%
Door/Wall	5	6	-18%	8	7	6%
Handheld Tools	86	80	7%	1026	984	4%
Mask	0	3	-200%	0	39	-200%
No Contact	195	210	-7%	230	233	-2%
Not in View	0	1	-200%	0	1	-200%
Polysacks Bag	53	74	-33%	185	180	3%
Toilet Pit	1	10	-164%	5	21	-125%
TOTAL	398	464	-15%	1749	1747	0%

S.2.2. Exposure Profiles for Farmers
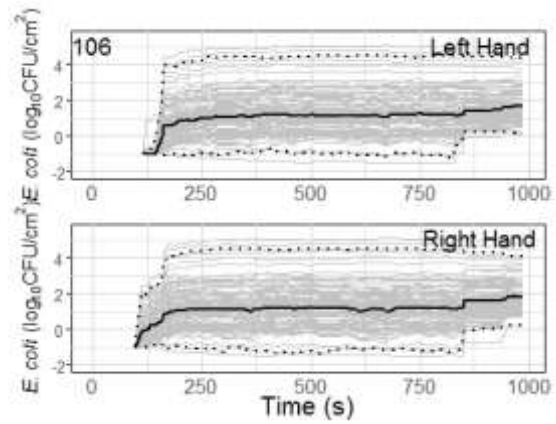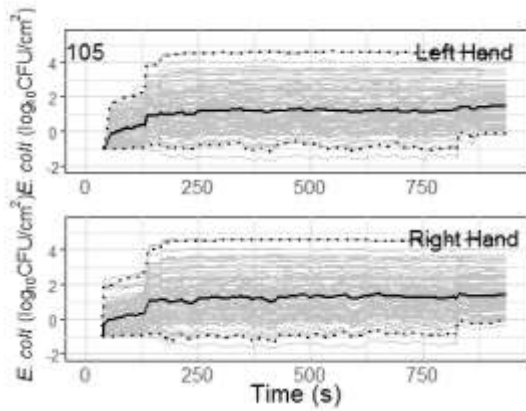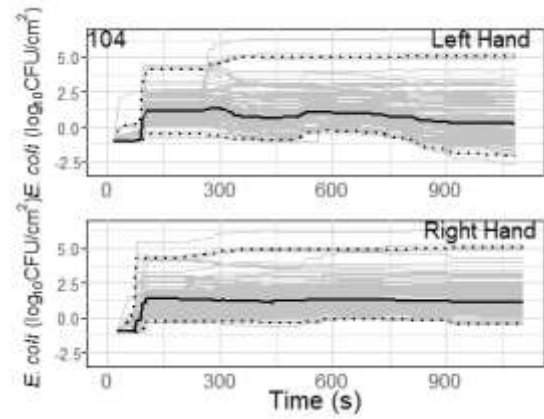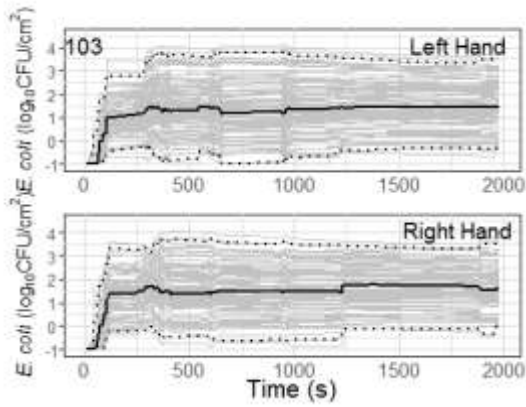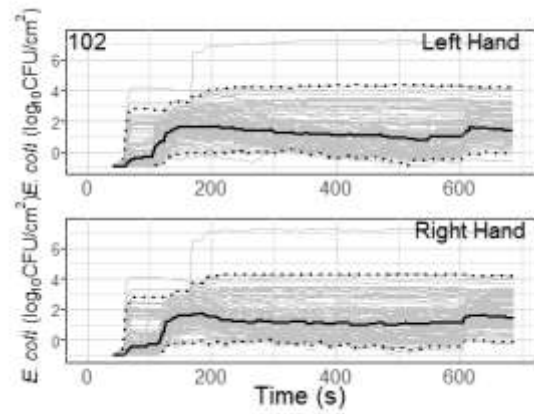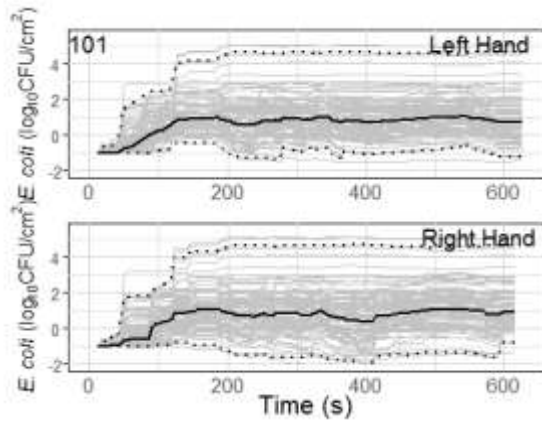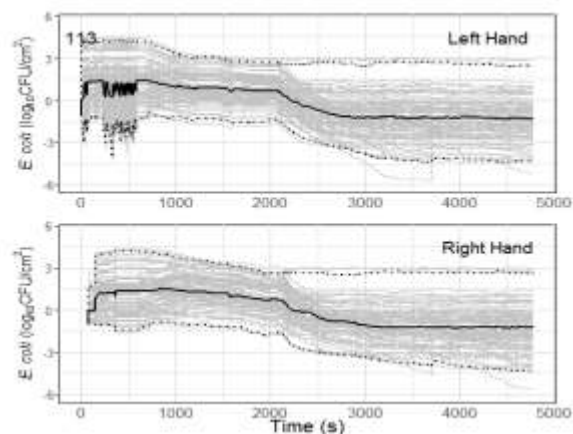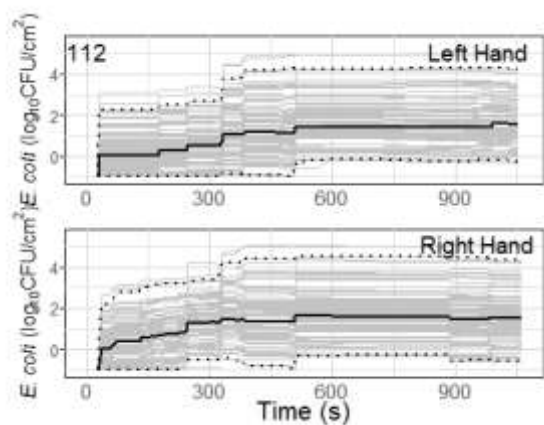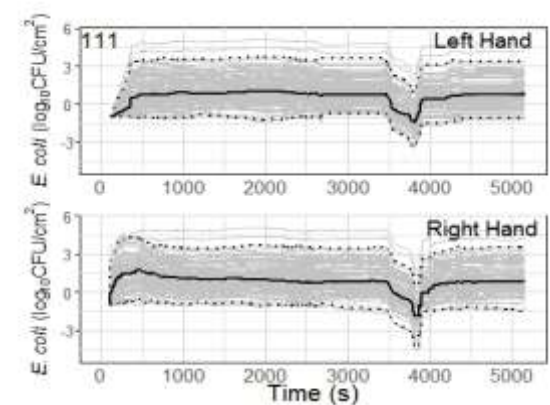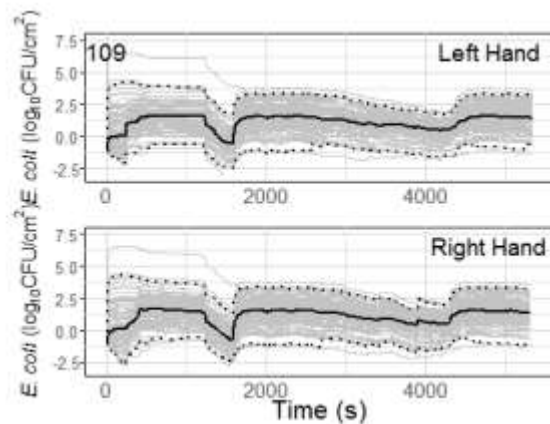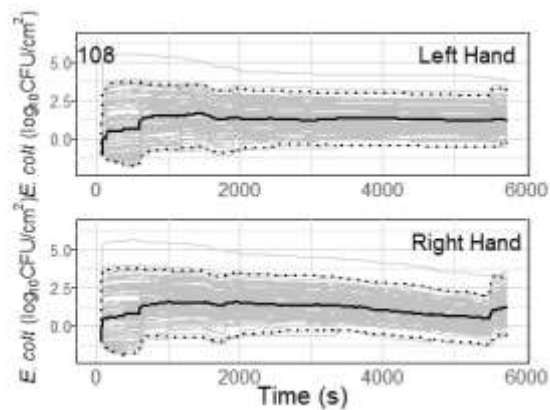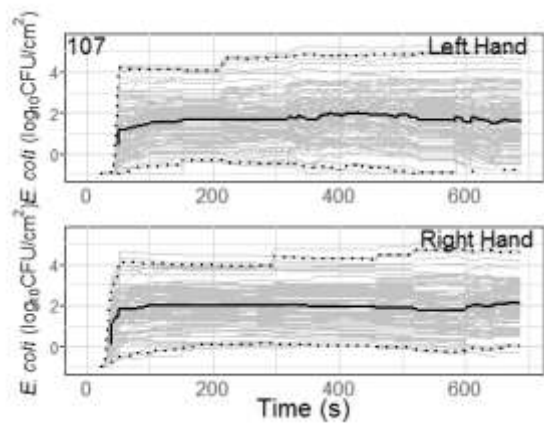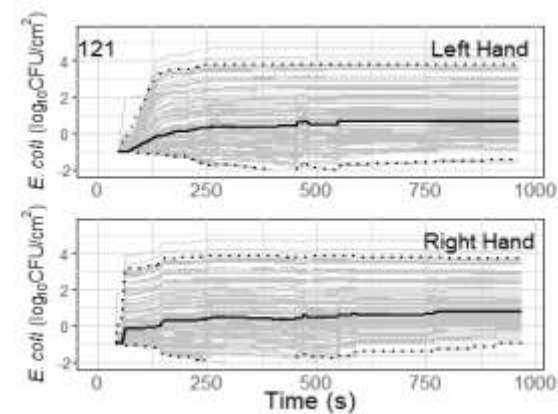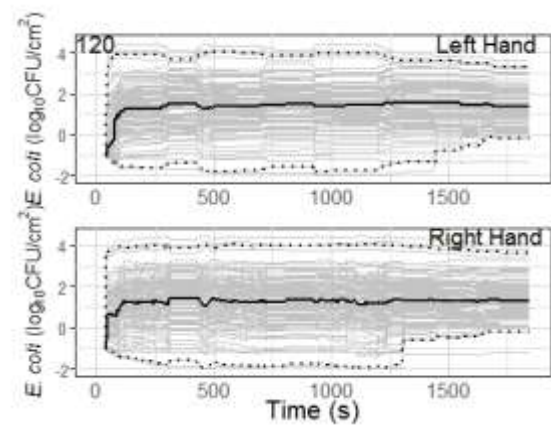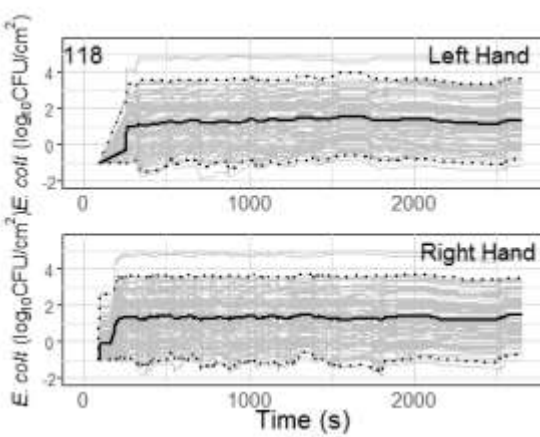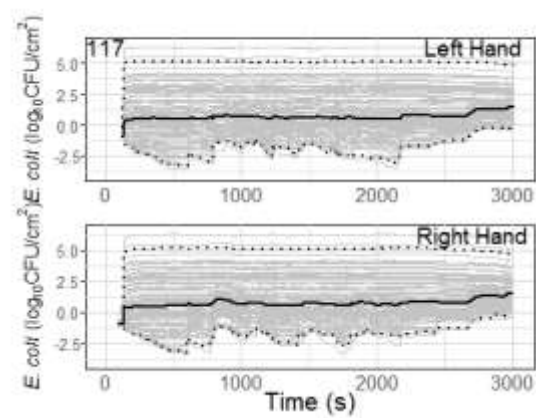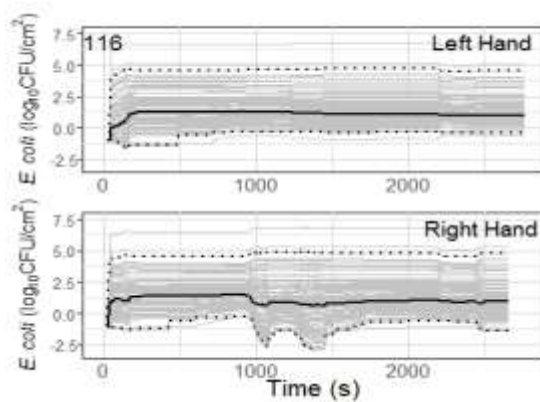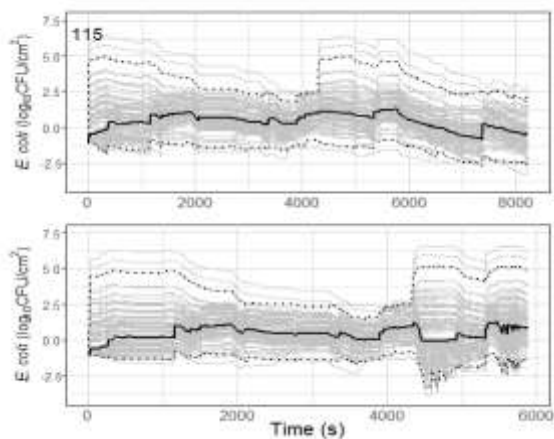
Figure S2: The time series of *E. coli* concentrations on (top) left and (bottom) right hands of farmers during collection and land application to agricultural fields from 100 simulations (solid, gray), with median (solid, black) and 95% range (dashed, black) concentrations.

S.2. 3. Sensitivity Analysis

Table S2: The median (p50), 10th percentile (p10), 90th percentile (p90) point values for Transfer (unitless), Object Concentration (CFU/100cm^2 for surfaces, CFU/100ml for water, and CFU/g-dry for Bulk Materials) and Surface Area (unitless) for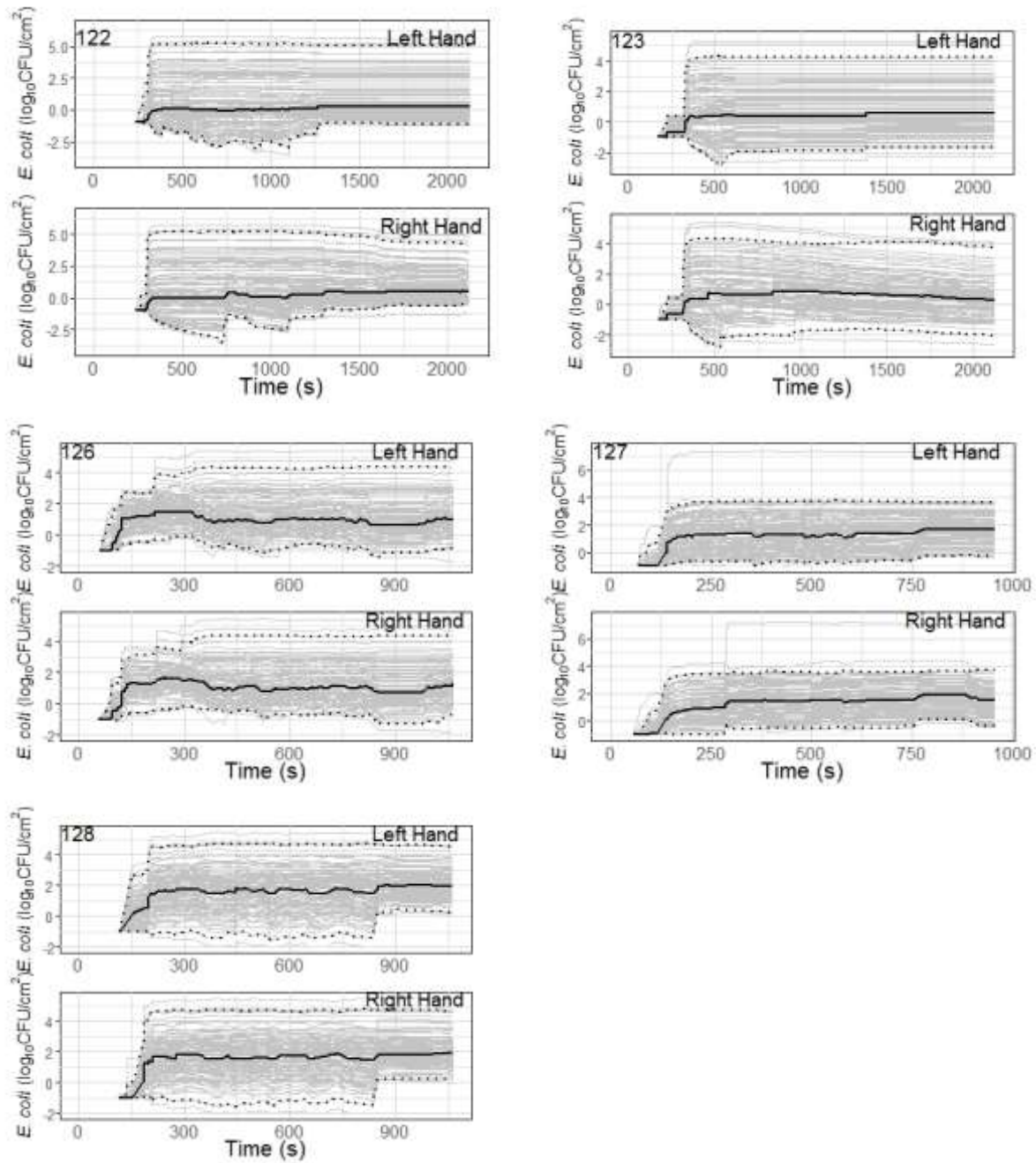 each object category as determined from the probability distribution functions (Tables 2 and 3) as well as the observed (obs), p10, and p90 point values for Activity (number of contacts per hour) for each object category as determined from the microlevel activity time series data.

| Object	Transfer			Object Concentration			Surface Area			Activity Collection			Activity Application		
	p50	p10	p90	p50	p10	p90	p50	p10	p90	obs.	p10	p90	obs.	p10	p90
Surfaces															
Handheld Tools	0.27	0	0.65	3.20	1.70	4.80	0.135	0.107	0.163	76.4	9.8	113.0	46.7	0	130.6
Polysacks Bag	0.007	0	0.017	2.00	0	4.20	0.050	0.042	0.058	26.7	0	50.8	8.7	0	32.3
Toilet Pit	0.27	0	0.65	3.70	2.40	5.10	0.155	0.111	0.199	11.7	0	42.0	0	0	0
Bucket (Plastic)	0.21	0.05	0.38	1.03	-0.50	2.50	0.135	0.107	0.163	16.7	0	60.8	5.8	0	27.9
Cloth	0.13	0	0.29	1.68	0.71	2.61	0.050	0.042	0.058	12.1	0	29.0	13.4	1.0	33.2
Polyethene Bag	0.21	0.05	0.38	0	0	2.92	0.050	0.042	0.058	11.5	0	50.8	22.6	0	73.4
Door/Wall	0.27	0	0.65	2.48	1.17	3.80	0.105	0.077	0.133	6.5	0	20.3	0.5	0	1.9
Mask	0.13	0	0.29	0	0	2.30	0.050	0.042	0.058	2.6	0	7.7	0.6	0	1.9
Bicycle	0.54	0.24	0.84	0	0	2.56	0.135	0.107	0.163	3.4	0	0	2.7	0	7.5
Footwear	0.35	0.10	0.59	1.93	-0.50	4.40	0.050	0.042	0.058	2.4	0	14.5	0.9	0	1.7
Grass	0.001	0	0.005	0.55	-1.36	2.46	0.105	0.077	0.133	0.8	0	3.4	17.1	0	83.9
Rice	0.37	0	0.87	0.55	-1.36	2.46	0.105	0.077	0.133	1.2	0	0	2.9	0	12
Paper Currency	0.001	0	0.005	0	0	0	0.050	0.042	0.058	0.3	0	0	0.3	0	0.8
Toilet Paper	0.001	0	0.005	0	0	0	0.050	0.042	0.058	0.3	0	1.7	0	0	0
Phone	0.38	0.25	0.51	0	0	2.86	0.135	0.107	0.163	0	0	0	0.4	0	1.9
Water															
Water/Surface	0.0036	0.0024	0.0047	3.92	2.82	4.96	0.280	0.264	0.296	0.7	0	0	12.5	0	37.9
Water/Drinking	0.0036	0.0024	0.0047	0.12	-0.87	1.15	0.280	0.264	0.296	0.8	0	3.8	0	0	0
Bulk Materials															
Excreta	0.22	0.17	0.27	4.00	1.25	6.70	0.190	0.142	0.238	95.6	1.7	184.5	52.1	3.1	117.0
Mud	0.49	0	1.17	2.02	0.22	3.79	0.070	0.046	0.094	5.8	0	0	69.4	3.7	127.8
Ash	0.22	0.17	0.27	0	0	2.53	0.190	0.142	0.238	2.7	0	0	5.1	0	19.1
Body															
Hands	0.33	0.17	0.48	0	0	0	0.135	0.107	0.163	1.1	0	3.4	10.5	0	33.5
Face	0.33	0.17	0.48	0	0	0	0.050	0.042	0.058	1.9	0	10.5	1.8	0	3.4
Mouth	0.34	0.03	0.66	0	0	0	0.140	0.108	0.172	0.7	0	3.4	0.4	0	1.4
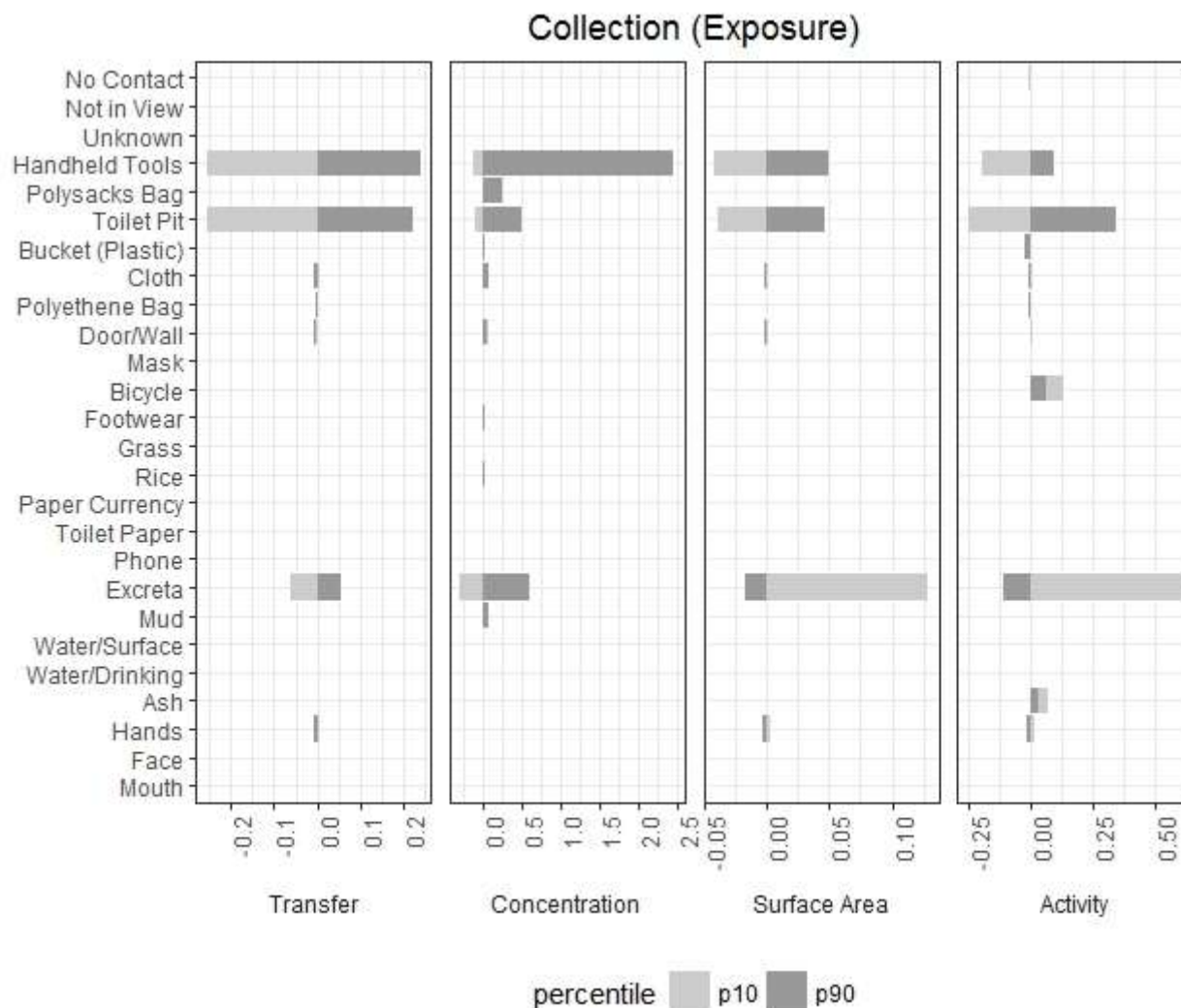
Figure S3: Sensitivity analysis for the exposure outcome (concentration of *E. coli* on hands in units of $\log_{10}$ CFU / cm^2) from a stochastic-mechanistic simulation of the collection of human excreta from dry toilets. For Transfer, Concentration, and Surface Area the abscissa refers to the fractional change in the median *E. coli* concentration on hands across all farmers caused by changing the median (p50) point estimate to the 10th (p10) or 90th (p90) point value drawn from the probability distribution function (see Table S2). For activity, the abscissa refers to the fractional change in the median *E. coli* concentration on hands across all farmers caused by changing the observed frequency of contacts with each object category for the 10th (p10) or 90th (p90) frequencies observed amongst all farmers. Note the differences in scales along the x-axis for Transfer, Concentration, Surface Area, and Activity.
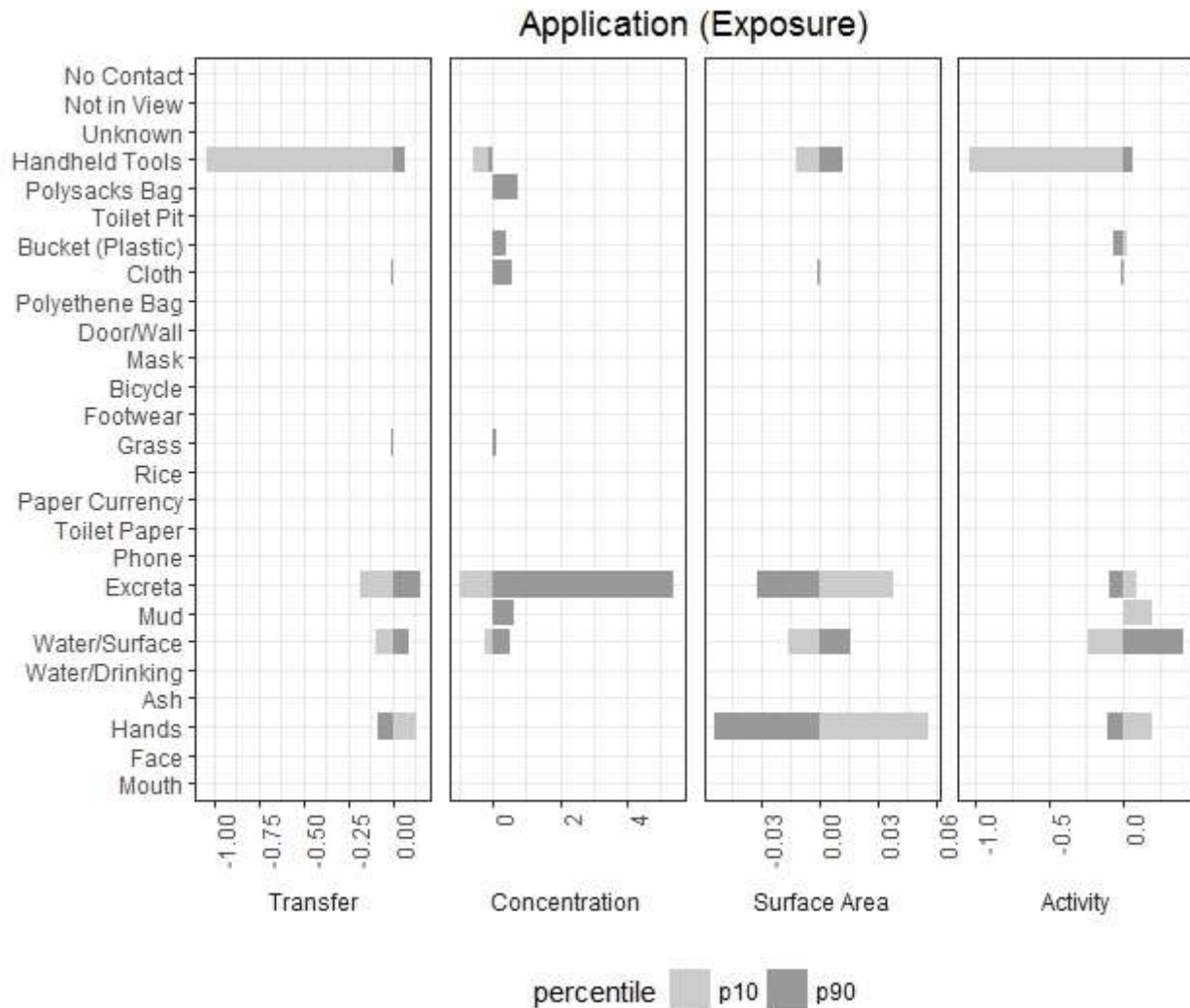
Figure S4: Sensitivity analysis for the exposure outcome (concentration of *E. coli* on hands in units of $\log_{10}$ CFU / cm^2) from a stochastic-mechanistic simulation of the application of excreta to agricultural fields. For Transfer, Concentration, and Surface Area the abscissa refers to the fractional change in the median *E. coli* concentration on hands across all farmers caused by changing the median (p50) point estimate to the 10th (p10) or 90th (p90) point value, as determined from the probability distribution function (see Table S2). For Activity, the abscissa refers to the fractional change in the outcome caused by changing the observed frequency of contacts with each object category to the 10th (p10) or 90th (p90) frequencies observed amongst all farmers. Note the differences in scales along the x-axis for Transfer, Concentration, Surface Area, and Activity.
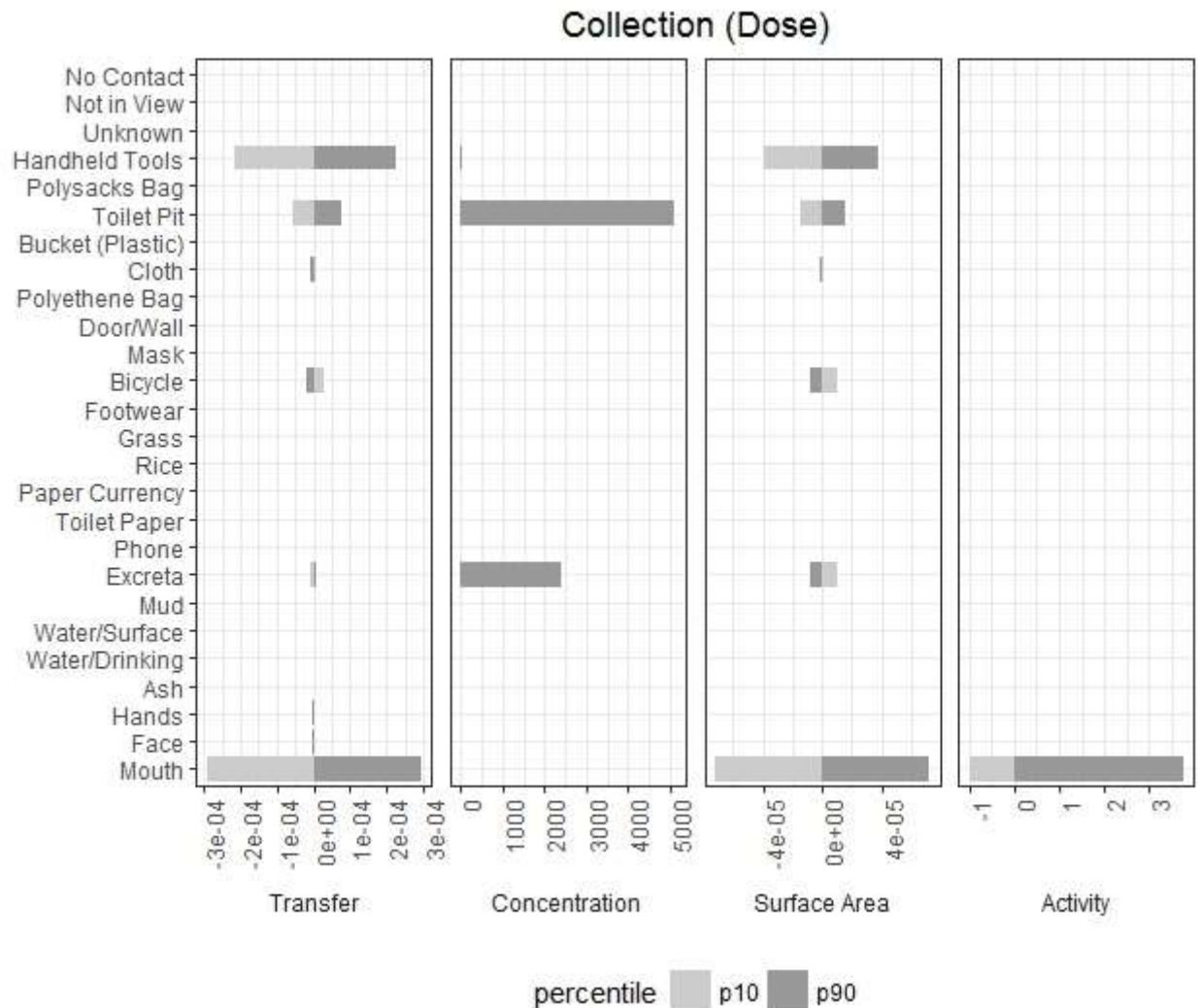
Figure S5: Sensitivity analysis for the dose outcome (total *E. coli* ingested in CFU) from a stochastic-mechanistic simulation of the collection of human excreta from dry toilets. For Transfer, Concentration, and Surface Area the abscissa refers to the fractional change in the ingested *E. coli* summed across all farmers caused by changing the median (p50) point estimate to the 10th (p10) or 90th (p90) point value drawn from the probability distribution function (see Table S2). For activity, the abscissa refers to the fractional change in the ingested *E. coli* summed across all farmers caused by changing the observed frequency of contacts with each object category for the 10th (p10) or 90th (p90) frequencies observed amongst all farmers. Note the differences in scales along the x-axis for Transfer, Concentration, Surface Area, and Activity.
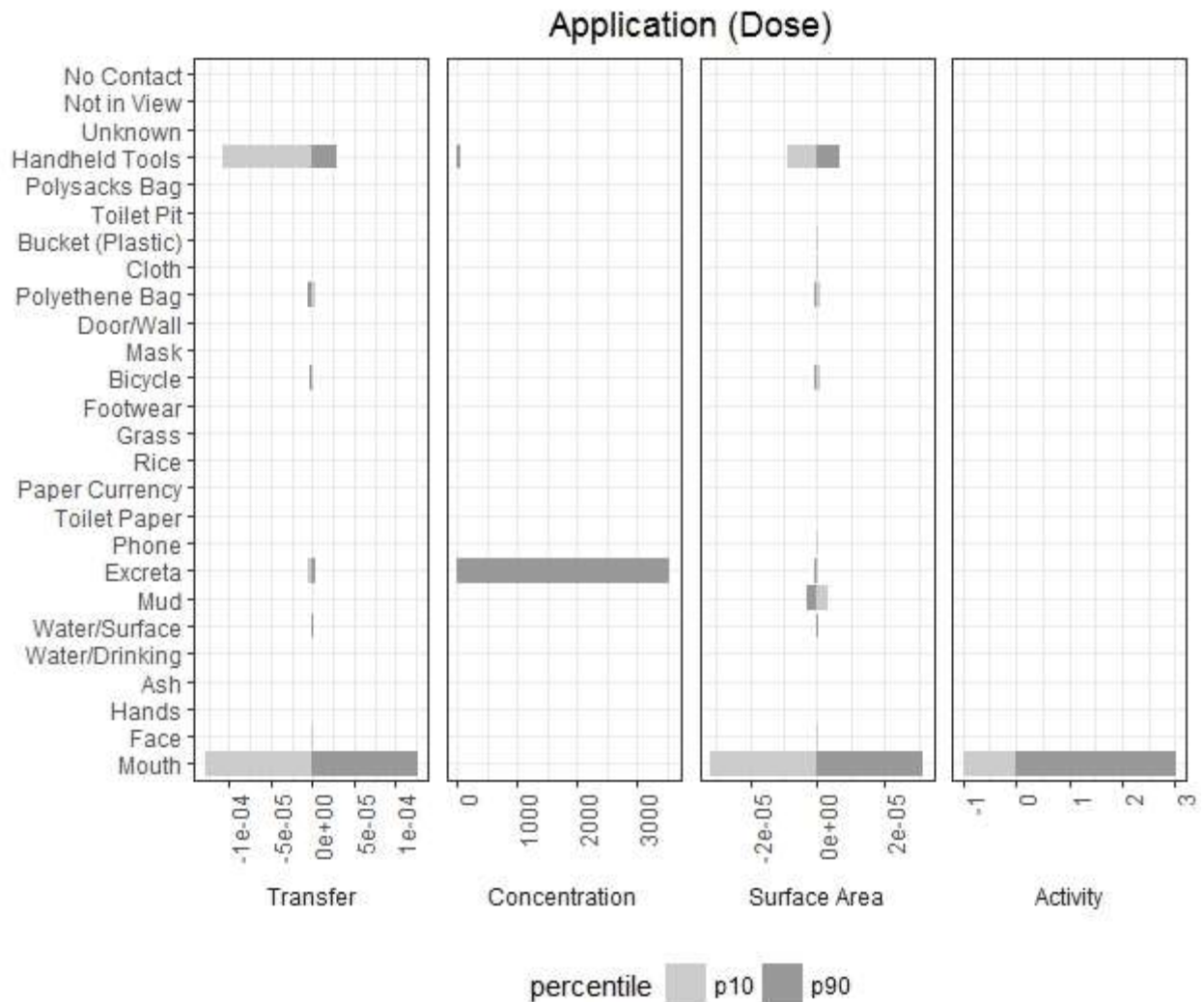
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Figure S6: Sensitivity analysis for the dose outcome (total *E. coli* ingested in CFU) from a stochastic-mechanistic simulation of the application of human excreta to agricultural fields. For Transfer, Concentration, and Surface Area the abscissa refers to the fractional change in the ingested *E. coli* summed across all farmers caused by changing the median (p50) point estimate to the 10th (p10) or 90th (p90) point value drawn from the probability distribution function (see Table S2). For activity, the abscissa refers to the fractional change in the ingested *E. coli* summed across all farmers caused by changing the observed frequency of contacts with each object category for the 10th (p10) or 90th (p90) frequencies observed amongst all farmers. Note the differences in scales along the x-axis for Transfer, Concentration, Surface Area, and Activity.
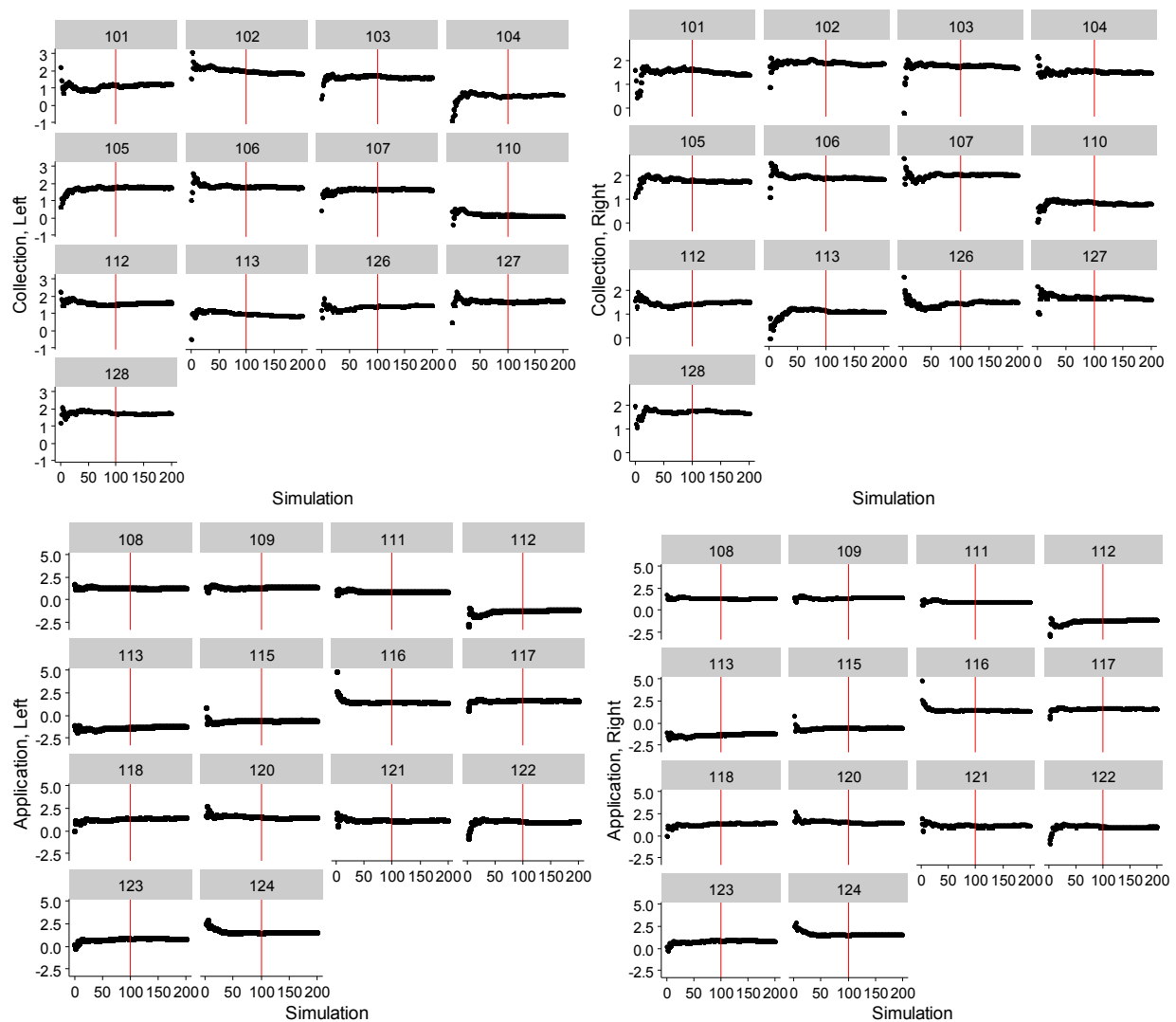
Figure S7: Simulation convergence on median *E. coli* concentrations as demonstrated by the average simulation E. coli concentrations over 200 simulations. Red line represents the 100 simulation count, which was used throughout the manuscript.

S.3. References

Kuroda, M., 2015. Study on Contamination and Exposure Analysis of Fecal Bacteria and Parasite Eggs in a Community Using Excreta in Rural Hanoi, Vietnam (M.Sc.). Kyoto University.

Niwagaba, C., Kulabako, R.N., Mugala, P., Jönsson, H., 2009. Comparing microbial die-off in separately collected faeces with ash and sawdust additives. Waste Manag. 29, 2214–2219.

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