Supplementary materials for:

Adapting Santiago method to determine appropriate and resource efficient sanitation systems for an urban settlement in Lima Peru

Ainul Firdatun Nisaa [1,2], Manuel Krauss [1,3]* and Dorothee Spuhler [4]

[1]Institute for Sanitary Engineering, Water Quality and Solid Waste Management, University of Stuttgart, 70569 Stuttgart, Germany

[2]Department of Environmental Engineering, Institut Teknologi Sepuluh Nopember, 60111 Surabaya, Indonesia; firdatun@its.ac.id, (current affiliation)

[3]Research Institute for Water and Waste Management at the RWTH Aachen University (FiW) e. V., 52072 Aachen, Germany (current affiliation)

[4]Swiss Federal Institute for Aquatic Science and Technology, 8600 Dübendorf, Switzerland; dorothee.spuhler@eawag.ch

*Correspondence: mail@manuel-krauss.de; Tel.: +49(0)241-802-6843

Table S1. Summary of the case profile used as inputs

	Screening criteria[1]	Case questions and metrics[1]	Probability function[2]	Description
1	Water supply	*What type of water supply is used by households?* Categories: a = none b = water well or spring or river (public) c = water tank or truck or pylon (yard) d = public network (house)	dcat c(a=0,b=0.09,c=0.41, d=0.5)	The proportion of households received or fetched water supply from a, b, c and d are 0%, 9%, 41% and 5% respectively [1].
2	Energy supply	*How many hours a day is electricity available at the household or facility level?* (hours/day)	dtrapez a=0,b=22,c=24,d=24	The daily supply of the energy is between 0 to 24 hours, commonly between 22 to 24 hours [1].

	Screening criteria[1]	Case questions and metrics[1]	Probability function[2]	Description
3	Water supply disruption	*How often does the water supply interrupt at the household level?* (hours/day)	dtrapez a=1,b=1,c=3,d=24	The probability of water supply getting disrupted is between 1 to 24 hours daily, commonly between 1 to 3 hours daily [1].
4	Energy supply disruption	*How often does the energy supply interrupt in a household?* (hours/day)	dtrapez a=1,b=1,c=3,d=24	The probability of energy supply getting disrupted is between 1 to 24 hours daily, commonly between 1 to 3 hours daily [1].
5	Frequency of O&M	*How feasible is it to find O&M labour for a specific workload?* (days/months/household)	prange lower=0,upper=2	The number of days per households / working units assumed to execute O&M for a given technology to be performed 100% is between 0 to 2 days per month based on the personal assessment (PA).
6	Spare parts supply	*How accessible are spare parts of each category?* Categories: 1- low-tech, 2- technical parts, 3- specially manufactured	pcat c(low.tech=1, technical.parts=1, specially.manufactured=0.3)	The capacity of the case study area to present spare parts supplies for both less advanced technology (low tech) and technical parts are 100%, while for specially manufactured tech is 30% based on PA.
7	Temperature	*What is the daily average temperature for one year?* (°C)	dtriangle a=12,b=28,c=20	The min and max temperatures in the case study area are 12 and 28 ºC respectively with the average of 20 ºC yearly [2].
8	Flooding	*How high are flooding levels at households or the facility?* (water height in cm)	drange lower=0,upper=1	Average flood heights are between 0 to 1 cm [3,4].
9	Vehicular access	*What is the width of the access roads to the technologies?* (street width in m)	dtrapez a=0,b=4,c=7,d=10	Street widths vary between 0 to 10 m, with the average of 4 to 7 m based on PA and [5].
10	Slope	*What is the slope distribution in the settlement?* (%)	dtriangle a=0,b=40,c=18	The min and max slopes in the case study area are 0 and 18% with the average of 40% based on PA and [5].
11	Soil type	*What is the soil type in the case-area?* Categories: a=clay, b=silt, c=sand, d=gravel	dcat c(clay=0.05, silt=0.05, sand=0.1, gravel=0.8)	The distribution of soil types in the case study area are clay (5%), silt (5%), sand (10%) and gravel (80%) based on PA and [6].
12	Groundwater depth	*What is the groundwater table at the households or the facility?* (water table in m)	dtrapez a=3,b=6,c=50,d=100	The min and max groundwater tables in the case study area are at 3 and 100 m respectively with the average of 6 to 50 m based on PA.

	Screening criteria[1]	Case questions and metrics[1]	Probability function[2]	Description
13	Surface area on-site	*How much surface area (m²) is available between the houses?* Categories: 1-low 2-moderate 3-high Assumptions: low = 0-5 moderate = 6-50 high = 50+	dcat c(low=0.7, moderate=0.2, high=0.1)	The availability of on-site facility areas for the given assumptions is mainly low (70%) based on PA.
14	Surface area off-site	*How much surface area (m²) is available at the facility site?* Categories: 1-low 2-moderate 3-high Assumptions: low = 0-50 moderate = 51-200 high = 200+	dcat c(low=0.6, moderate=0.2, high=0.2)	The availability of off-site facility areas for the given assumptions is mainly low (60%) based on PA.
15	Construction skills	*What levels of professions for construction are available in this area?* Categories: 1-none 2-mason 3-specially trained mason 4-construction engineer 5-supervisor	ptrapez a=1,b=2,c=5,d=5	The min and max construction skills available in the case study area are skill 1 and 5, commonly available is between skills 2 to 5 based on PA.
16	Design skills	*What levels of professions for design are available in this area?* Categories: 1-none 2-unskilled labour 3-mason 4-specially trained mason 5-planning engineer 6-supervisor	ptrapez a=1,b=2,c=6,d=6	The min and max construction skills available in the case study area are skill 1 and 6, commonly available is between skills 2 to 6 based on PA.
17	O&M skills	*What level of professions for O&M are available in this area?* Categories: 1-none 2-unskilled labour 3-specially trained labour 4-technician 5-supervisor 6-administrator 7-engineer 8-scientist	ptrapez a=1,b=2,c=7,d=7	The min and max construction skills available in the case study area are skill 1 and 7, commonly available is between skills 2 to 7 based on PA.

	Screening criteria[1]	Case questions and metrics[1]	Probability function[2]	Description
18	Management	*What kind of management is possible/preferred?* Categories: 1-household, 2-shared, 3-public	dcat c(household=0.8, shared=0.1, public=0.1)	Household management is assumed to be more applicable in the case study area (80%), followed by shared (10%) and public management (10%) based on PA.

[1]adapted from [7].

[2]the probability function can be a range, triangle, trapezium, or category function. Each screening criteria or attribute consists of one probability density or distribution function (d-function) and one conditional probability or performance function (p-function). The method is based on [7].

Table S2. Summary of the technology profile example used as inputs

Nr.	Screening criteria[1]	Possible technology probability function[2]	Fossa *alterna* (S)	*Condominial* sewer (C)	Anaerobic filter (T)	Trickling filter (T)	Activated sludge (T)
References			[8–12]	[13]	[14–17]	[9,18–24]	[9,20,25–32]
Technical							
1	Water supply	pcat	n.a.	n.a.	n.a.	n.a.	n.a.
2	Energy supply	prange; ptriangle	lower=0, upper=24	lower=0, upper=24	lower=0, upper=24	a=0, b=24, c=24	a=0, b=24, c=24
3	Water supply disruption	prange; ptriangle	n.a.	n.a.	n.a.	n.a.	n.a.
4	Energy supply disruption	prange; ptriangle	lower=0, upper=24	lower=0, upper=24	lower=0, upper=24	a=0, b=24, c=0	a=0, b=24, c=0
5	Frequency of O&M	drange; dtriangle	lower=1, upper=4	a=0, b=4, c=2	lower=1, upper=2	lower=1, upper=2	lower=1, upper=2
6	Spare parts supply	dcat	c(low.tech=1, technical.parts=0 , specially.manufactured=0)	c(low.tech=1, technical.parts=0 , specially.manufactured=0)	c(low.tech=1, technical.parts=0 , specially.manufactured=0)	c(low.tech=0.5, technical.parts=0.4, specially.manufactured=0.1)	c(low.tech=0.5, technical.parts=0.4, specially.manufactured=0.1)
Physical							
7	Temperature	prange; ptriangle; ptrapez	lower=15, upper=24	lower=-10, upper=50	a=5, b=15, c=35, d=50	a=-5, b=10, c=40, d=50	a=-5, b=10, c=40, d=50
8	Flooding	prange; ptrapez	a=0, b=0, c=6, d=30	a=0, b=0, c=20, d=365	a=0, b=0, c=6, d=60	a=0, b=0, c=6, d=60	a=0, b=0, c=12, d=60
9	Vehicular access	prange; ptrapez	a=1, b=3, c=100, d=100	a=1, b=3, c=100, d=101	a=1, b=3, c=100, d=100	a=1, b=3, c=100, d=100	a=1, b=3, c=100, d=100
10	Slope	prange; ptrapez	a=0, b=0, c=5, d=25	a=0.5, b=4, c=100, d=100	a=0, b=0, c=50, d=100	a=0, b=0, c=0, d=100	a=0, b=0, c=0, d=100
11	Soil type	pcat	c(clay=0,silt=0.5, sand=1, gravel=1)	c(clay=1,silt=1, sand=1, gravel=1)	c(clay=0.5,silt=1, sand=1, gravel=0.5)	c(clay=1,silt=1,sand=1, gravel=1)	c(clay=1,silt=1,sand=1, gravel=1)
12	Groundwater depth	prange; ptrapez	a=3.5, b=6, c=100, d=100	a=3, b=7, c=100, d=100	lower=3.5, upper=100	lower=0, upper=100	lower=2, upper=100
13	Surface area on-site	pcat	c(low=1, moderate=1, high=1)	n.a.	n.a.	n.a.	n.a.

Nr.	Screening criteria[1]	Possible technology probability function[2]	Fossa *alterna* (S)	*Condominial* sewer (C)	Anaerobic filter (T)	Trickling filter (T)	Activated sludge (T)
14	Surface area off-site	pcat	n.a.	n.a.	c(low=0.5, moderate=1, high=1)	c(low=0, moderate=1, high=1)	c(low=0, moderate=1, high=1)
Capacity and managerial							
15	Construction skills	drange; dtriangle	a=1, b=3, c=2	lower=3, upper=5	a=2, b=4, c=3	a=3, b=5, c=4	a=1, b=3, c=2
16	Design skills	dtriangle	a=3, b=5, c=4	a=4, b=6, c=5	a=3, b=5, c=4	a=4, b=6, c=5	a=3, b=5, c=4
17	O&M skills	drange; dtriangle	a=2, b=4, c=3	lower=3, upper=5	a=2, b=4, c=3	a=2, b=4, c=3	a=2, b=4, c=3
18	Management	pcat	c(household=1,shared=1, public=0.5)	c(household=0.5,shared=1, public=1)	c(household=0.5,shared=1, public=1)	c(household=0,shared=0, public=1)	c(household=0,shared=0, public=1)
Transfer coefficients							
Total phosphorus			Pit humus = 0.60 Air-loss = 0.00 Soil-loss = 0.40 Water-loss = 0.00 $k = 100$	Effluent = 0.90 Air-loss = 0.00 Soil-loss = 0.10 Water-loss = 0.00 $k = 25$	Sludge = 0.67 [0.48 – 0.86] Effluent = 0.33 Air-loss = 0.00 Soil-loss = 0.00 Water-loss = 0.00 $k = 25$	Sludge = 0.26 [0.10 – 0.50] Effluent = 0.74 Air-loss = 0.00 Soil-loss = 0.00 Water-loss = 0.00 $k = 5$	Sludge = 0.50 [0.00 – 0.88] Effluent = 0.50 Air-loss = 0.00 Soil-loss = 0.00 Water-loss = 0.00 $k = 0.5$
Total nitrogen			Pit humus = 0.65 [0.60 – 0.70] Air-loss = 0.00 Soil-loss = 0.35 Water-loss = 0.00 $k = 100$	Effluent = 0.85 Air-loss = 0.05 Soil-loss = 0.10 Water-loss = 0.00 $k = 25$	Sludge = 0.22 [0.15 – 0.56] Effluent = 0.78 Air-loss = 0.00 Soil-loss = 0.00 Water-loss = 0.00 $k = 2$	Sludge = 0.39 [0.00 – 0.64] Effluent = 0.61 Air-loss = 0.00 Soil-loss = 0.00 Water-loss = 0.00 $k = 1$	Sludge = 0.46 [0.00 – 0.63] Effluent = 0.54 Air-loss = 0.00 Soil-loss = 0.00 Water-loss = 0.00 $k = 1$
Total solids			Pit humus = 0.85 Air-loss = 0.05 Soil-loss = 0.10 Water-loss = 0.00 $k = 5$	Effluent = 0.90 Air-loss = 0.00 Soil-loss = 0.10 Water-loss = 0.00 $k = 25$	Sludge = 0.64 [0.39 – 0.73] Effluent = 0.36 Air-loss = 0.00 Soil-loss = 0.00	Sludge = 0.2 [0.14 – 0.72] Effluent = 0.80 Air-loss = 0.00 Soil-loss = 0.00	Sludge = 0.94 [0.75 – 0.99] Effluent = 0.06 Air-loss = 0.00 Soil-loss = 0.00

Nr.	Screening criteria[1]	Possible technology probability function[2]	Fossa *alterna* (S)	*Condominial* sewer (C)	Anaerobic filter (T)	Trickling filter (T)	Activated sludge (T)
					Water-loss = 0.00 $k = 5$	Water-loss = 0.00 $k = 2$	Water-loss = 0.00 $k = 5$
Water			Pit humus = 0.05 Air-loss = 0.10 Soil-loss = 0.85 Water-loss = 0.00 $k = 5$	Effluent = 0.90 Air-loss = 0.00 Soil-loss = 0.10 Water-loss = 0.00 $k = 25$	Sludge = 0.05 Effluent = 0.95 Air-loss = 0.00 Soil-loss = 0.00 Water-loss = 0.00 $k = 25$	Sludge = 0.04 Effluent = 0.93 Air-loss = 0.03 Soil-loss = 0.00 Water-loss = 0.00 $k = 25$	Sludge = 0.04 Effluent = 0.93 Air-loss = 0.03 Soil-loss = 0.00 Water-loss = 0.00 $k = 25$

[1]adapted from [36].

[2]the probability function can be a range, triangle, trapezium, or category function. Each screening criteria or attribute consists of one probability density or distribution function (d-function) and one conditional probability or performance function (p-function). The method is based on [7].
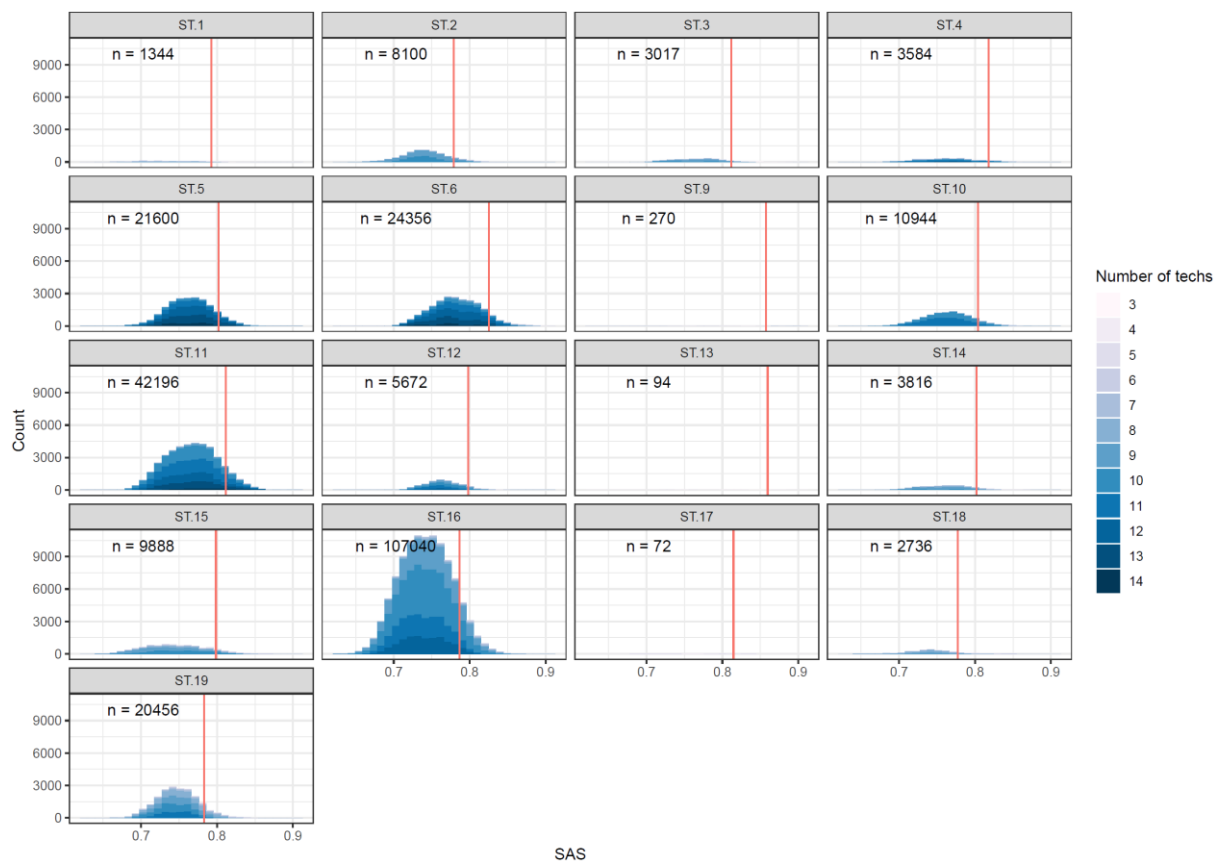
Figure S1. Histogram of sanitation system appropriateness score of all valid systems, grouped by system template and colored by the number of technologies per system. The vertical red line indicates the 90th percentile of the histogram. (SAS = sanitation system appropriateness score; ST = system template; n = total number of sanitation systems)

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