International Water Association

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5th IWA Specialized Conference on Resources-Oriented Sanitation

ASSESSMENT OF DECENTRALIZED WASTEWATER TREATMENT SYSTEMS IN THE RURAL AREA OF CUENCA, ECUADOR.

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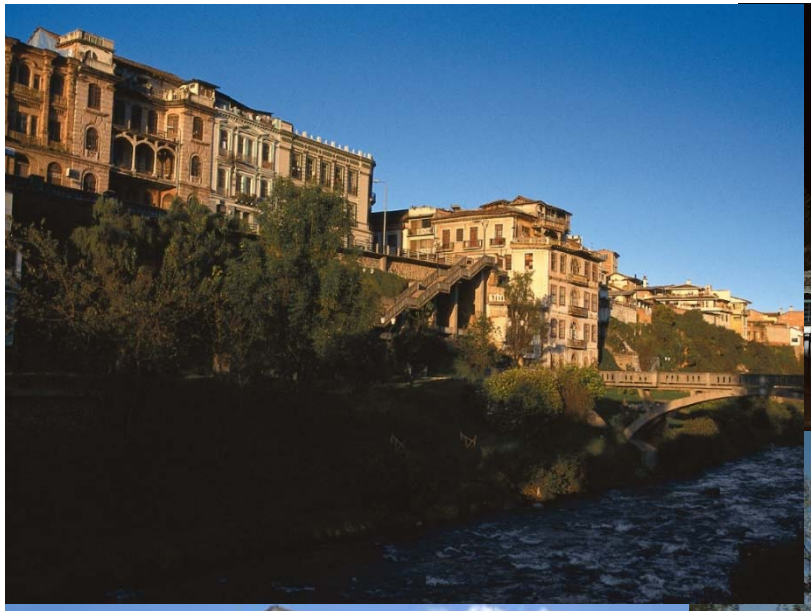
cuenca I. MUNICIPALIDAD ETAPA

content

- **Introduction**
  - Cuenca and the rural systems
  - Long term objectives
- **Problem Statement / Objectives**
- **Methods**
  - Information analysis
  - Characterization
- **Results / discussion**
- **Conclusions / perspectives**

CUENCA – ECUADOR

0.5 million inhabitants, third largest city of Ecuador
Ecuadorian leader in sanitation services: 95% sewerage; 90% wastewater treatment (WSP)





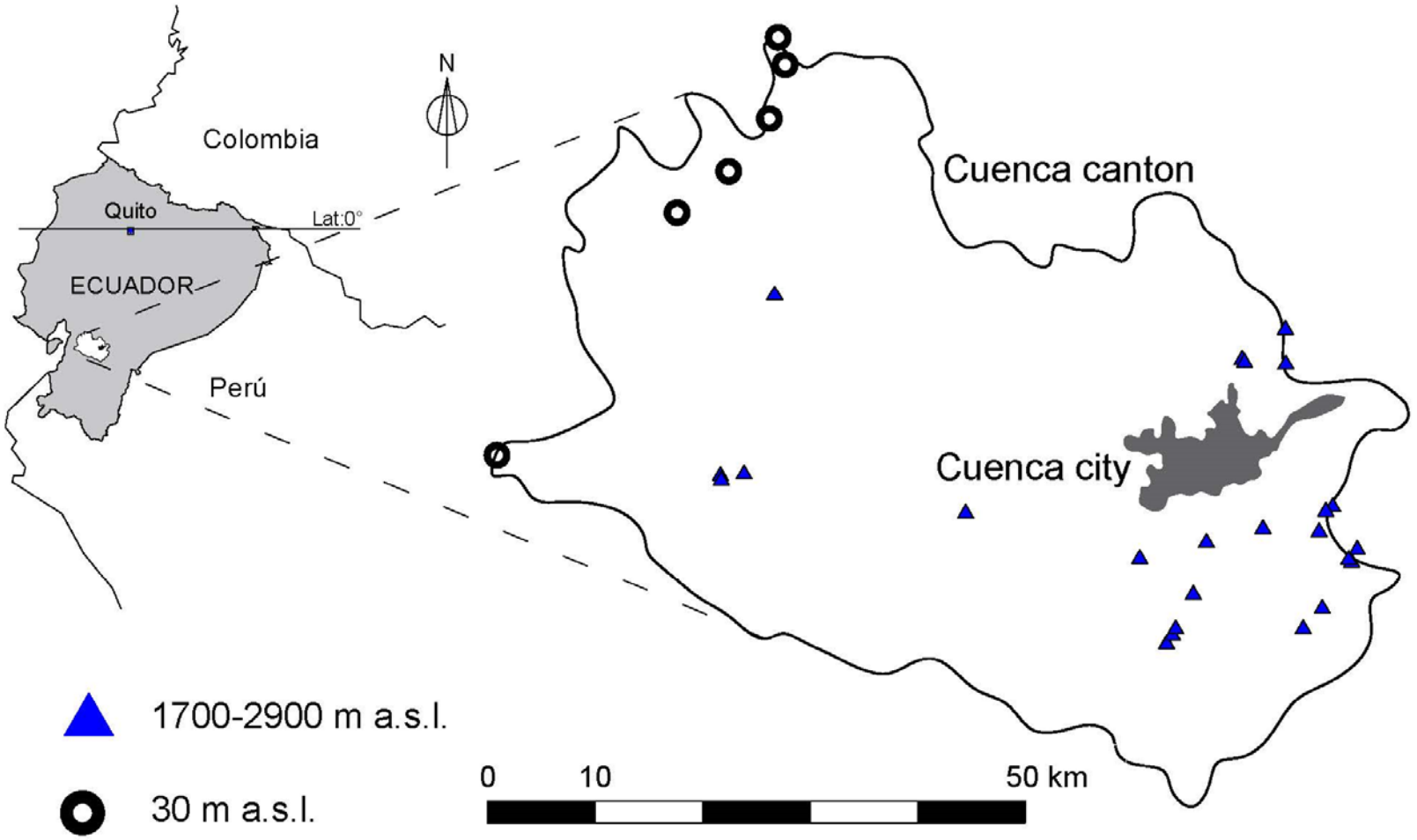


Ucubamba WSP, The biggest WWTP in ECUADOR

- DBO=85%, sólidos=95%, Patógenos= log7 – log4
- Remoción en línea de lodos (2013)

The Decentralized Systems

- 32 systems. Constructed in the last 20 years. Located in rural areas
- Serving around 100 000 inhabitants



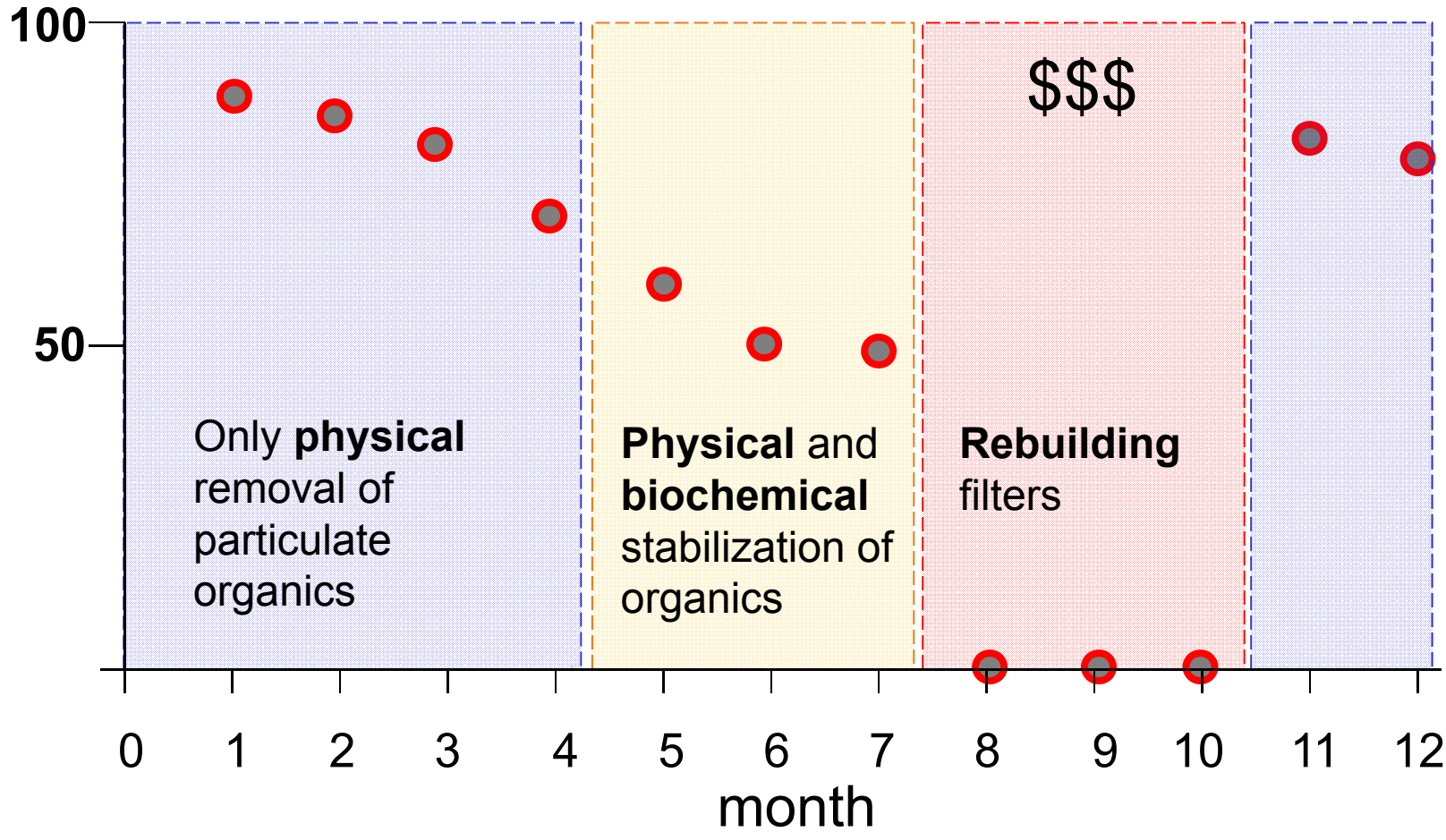
The Decentralized Systems

- **Problem statements:**
  - The systems are progressively abandoned
  - There were inconsistencies in the efficiencies reported
  - A preliminary inspection showed collapsed systems and very low biological activity in others

- **Objective**: a real assessment of the systems as baseline for taking decisions about the sanitation of the rapid urbanization in the surroundings of Cuenca

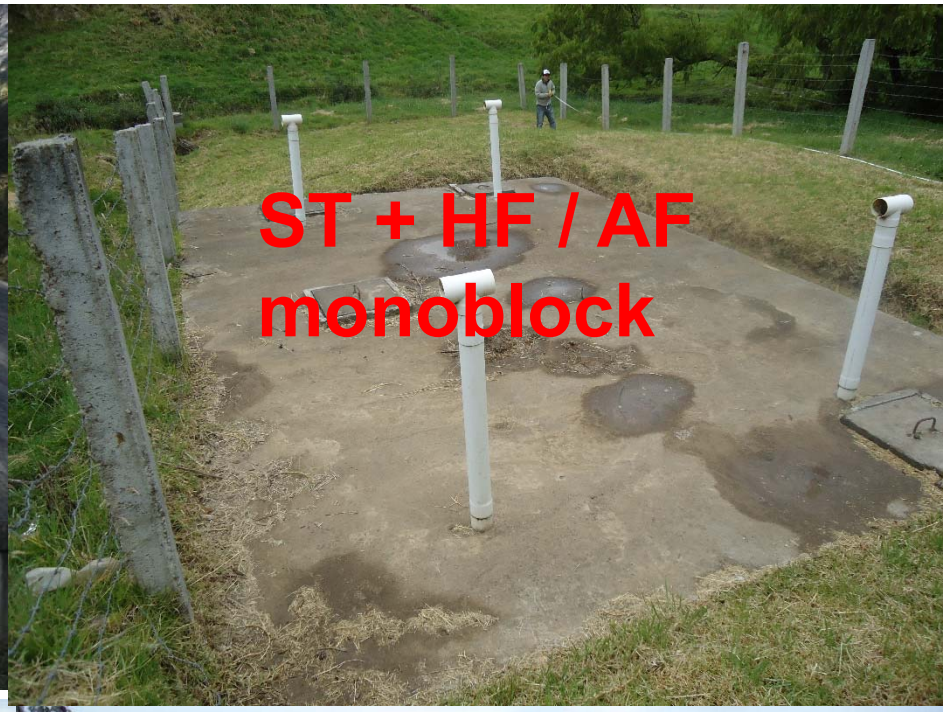
- **Methods**: analysis of the information supplied by the agency, inspections and characterization

Analysis of the information of the agency: Systems deteriorated or with very low biological activity reported very good efficiencies…



N°	Access Roads	Served Area	Altitude	T	O&M Plan	Preliminary Treatment			Primary Treatment			Secondary Treatment			Sludge drying bed	Final Disposal
		ha	m a.s.l	°C		By-Pass	Screen	Grit Chamber	Type	Chamber	L;W;D [m]	Type-number	Filter Media	L;W;D [m]		
3	✓	72.2	30	22	✓	OS	✓	---	ST	2	N/D	FWSW-2	---	N/D	✓	Stream
4	✓	N/D	30	22	✓	OS	✓	✓	ST	2	N/D	FWSW-2	---	N/D	✓	TL
5	✓	55.8	30	22	✓	OS	✓	---	ST	2	N/D	FWSW-2	---	N/D	✓	TL
6	✓	417.5	30	22	✓	OS	✓	---	ST	2	N/D	FWSW-1	---	N/D	✓	Infil
7	✓	43.5	30	22	✓	OS	✓	---	ST	2	N/D	HF/AF	Gravel	---	✓	TL
8	✓	N/D	30	22	✓	OS	✓	---	ST	2	N/D	FWSW-1	---	N/D	✓	Stream
9	---	N/D	1700	18	✓	---	✓	---	ST	2	N/D	VF/AF	Gravel	---	---	Stream
10	---	N/D	1700	18	✓	N/D			ST	N/D		HF/AF	N/D	---	---	N/D
11	---	75.2	1700	18	✓	N/D			ST	N/D		HF/AF	N/D	---	---	N/D
12	---	75.2	2440	17	---	OS	---	---	ST	2	N/D	---	---	---	---	Stream
13	---	54.3	2440	17	✓	N/D			ST	N/D		AF/--	N/D	---	---	N/D
14	✓	226.5	2500	11	✓	---	✓	✓	ST	2	11,9;3,4;2,5	FWSW-2	---	34,5;20,2;1,8	✓	Stream
15	✓	49.3	2500	11	---	OS	✓	✓	ST	2	N/D	VF/AF	Brick	---	✓	Stream
16	✓	40.3	2500	11	---	---	✓	---	ST	2	N/D	VF/AF	Gravel	---	✓	Stream
17	✓	150.8	2520	15	✓	OS	✓	---	UASB	3	N/D	HF/AF	Gravel	---	✓	Stream
18	---	N/D	2550	17	✓	OS	✓	---	ST	3	7,3;3,0;2,9	FWSW-1	---	31,7;18,7;2,5	✓	Stream
19	✓	129.4	2582	14	✓	---	✓	---	ST	2	N/D	VF/AF	Brick	---	---	Stream
20	✓	41.5	2582	14	✓	OS	✓	---	ST	2	N/D	VF/AF	Brick	---	✓	Stream
21	---	47.9	2600	17	✓	---	---	✓	ST	2	N/D	VF/AF	Brick	---	---	Stream
22	✓	25.4	2600	14	✓	OS	---	---	ST	2	9,4;3,1;1,5	VF/AF	Brick	---	✓	Stream
23	---	24.4	2600	17	---	OS	✓	---	ST	2	9,4;3,0;1,5	VF/AF	Gravel	---	---	Stream
24	✓	71.0	2600	17	✓	OS	✓	---	ST	2	11,1;4,3;2,7	VF/AF	Brick	2,5 Di 3,3 D	✓	Stream
25	✓	32.9	2600	17	✓	OS	✓	✓	ST	2	9,4;3,1;1,5	VF/AF	Brick	---	✓	Stream
26	---	8.6	2600	17	---	---	---	---	ST	2	N/D	HF/AF	Gravel	---	---	Stream
27	✓	11.1	2792	15	---	---	---	---	ST	2	7,6;2,9;2,9	HF/AF	Gravel	7,6;2,9;2,9	---	Stream
28	✓	103.6	2792	15	---	---	✓	---	ST	2	N/D	VF/AF	Gravel	---	✓	Stream
29	---	38.4	2820	17	✓	N/D			ST	4	4,8;4,7;1,5	---	---	---	---	Stream
30	✓	605.1	2852	11	✓	OS	✓	---	ST	2	11,0;3,9;2,8	FWSW-2	---	N/D	✓	N/D
31	✓	76.5	2900	12	✓	OS	✓	---	ST	4	N/D	VF/AF	Brick	---	✓	Stream
32	✓	55.8	3500	5	✓	---	---	---	ST	1	N/D	HF/AF	Gravel	---	✓	Stream


ST + VF / AF


ST + HF / AF
monoblock


ST + FWSW

N°	Date	Discharge	BOD_5		COD		TKN		TP		TSS		TS		pH
		m^3/day	mg / L												-
			Inf	Rem	Inf	Rem	Inf	Rem	Inf	Rem	Inf	Rem	Inf	Rem	Inf
1	Feb, 2009	---	155	60%	347	47%	13.5	N/D	5.7	N/D	222	N/D	821	N/D	7.6
2	Sep, 2009	---	58	81%	24	-11%	N/D		N/D		23	35%	154	12%	6.7
14	June, 2014	---	30	60%	174	59%	6.0	-25%	1.4	22%	74	88%	268	20%	6.7
	Feb, 2016		170	90%	603	85%	12.5	52%	3.2	67%	496	98%	776	72%	6.8
15	Feb, 2016	---	420	89%	1744	95%	83	54%	4.6	13%	1636	98%	1984	79%	6.7
17	Dec, 2015	---	100	60%	279	61%	53	41%	3.9	23%	156	85%	518	37%	7.2
	May, 2016	126	47	79%	218	64%	23	35%	1.8	16%	114	95%	506	16%	7.0
18	June, 2014	---	33	70%	149	77%	3	32%	1.5	64%	53	45%	162	44%	7.0
22	2015	20	49	67%	113	53%	N/D		3.3	48%	21	48%	169	8%	---
	Apr, 2016	---	245	90%	977	97%	44	49%	3.4	28%	1550	99%	1842	87%	6.7
23	Oct, 2015	33	365	86%	839	70%	134	14%	7.5	0.2	436	95%	1134	47%	7.3
	Feb, 2016		170	48%	413	15%	51	-67%	4.4	-0.8	26	-177%	557	-2%	7.6
24	June, 2014	---	580	96%	2038	94%	229	98%	N/D		229	91%	1236	69%	9.2
25	Dec, 2015	20	265	71%	684	62%	122	23%	11.9	23%	161	70%	815	37%	7.4
	May, 2016		375	86%	818	77%	74	34%	7.0	41%	210	86%	930	46%	7.3
27	Oct, 2015	---	223	92%	440	85%	53	72%	3.1	58%	72	93%	593	65%	7.1
	Mar, 2016	---	58	60%	142	68%	26	5%	3.3	34%	69	88%	298	24%	6.8
28	Jan, 2009	---	10	-150%	32	-128%	1.3	-122%	N/D		43	23%	283	-46%	7.0
	Feb, 2015	---	46	59%	147	66%	26	-5%	1.7	-0.1	62	81%	344	19%	7.1
29	2015	24	63	-27%	142	-29%	---	---	3.9	15%	62	-85%	601	-36%	---
30	Sep, 2010	---	133	81%	313	70%	N/D		7.4	25%	95	80%	407	-42%	7.3
	May, 2016		225	76%	841	70%	21.4	56%	18.9	92%	840	73%	1376	56%	6.3
31	Mar, 2016	---	620	95%	2488	94%	238	77%	22.4	75%	2412	99%	2742	86%	6.7
32	---	---	---	---	---	---	---	---	---	---	62	-85%	---	---	---

Technology	# of systems	Removal min; mean; max	recurrent problems observed
ST + HF/AF	7	COD: 61; 75; 85% (2); TC: <0; <1; 2 log (2)	Clogging of ST and AFs
ST + VF/AF	12	COD: -118; 54; 97% (7); TC: <0; <1; 5 log (7)	Clogging of ST and AFs; organic overload;
ST + FWSW	8	COD:59; 73; 85% (3); TC: <0; <1; 1 log (3)	Clogging of ST; Clogging of ST; short circuiting in FWSW
ST + FWSW + Infil	1	-	-
UASB + HF/AF	1	COD: 62% (1); TC: <1 log (1)	Organic overload; clogging of AFs
Only ST	2	COD: -28% (1); TC: <1 log (1)	Clogging of ST

COD: Chemical Oxygen demand; TC: Total coliforms; (N) Number of systems characterised; ST: Septic Tank; AF: Anaerobic Filter; HF: Horizontal Flow; VF: Vertical Flow; FWSW: Free Water Surface Wetland; Infil: Soil Infiltration; UASB: Upflow anaerobic sludge blanket; OUT: Currently out of operation.

- Some systems present **design** and construction **failures**
- There is **organic overload** in many systems, mainly due to **rapid increase of new connections** to the sewerage network
- The **preliminary structures** are **too small** to retain the particulate material during **rainfall events**
- Very low and even **null biological activity** was observed in the majority of the systems in operation due to the **erroneous starting up and maintenance of the systems**
- Despite of some organic matter removal, the systems are not eliminating pathogens
- Many **similarities between systems** were found, which could suggest the **application of design guidelines** some decades ago
- **Access roads** and fences are **urgently** needed in many systems

- **Perspectives: pilot scale systems will be implemented soon**

Thank you for your kind attention

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