

FIFTEEN YEARS OF WATER SANITATION IN EASTERN ANTIOQUIA, COLOMBIA

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Abstract

This work evaluates the application of CORNARE's water sanitation program during the period 1995–2010 to identify its strengths and weaknesses in providing adequate sanitation services in the region. Our analysis focuses on preliminary treatment, high-rate primary sedimentation and anaerobic digester of primary sludge. The evaluation shows that the wastewater primary treatment facilities present sewage treatment performances for TSS and BOD5 between 50 to 65%. Due to economies of scale, the use of primary treatment systems based on high-rate primary sedimentation has optimum values for populations over 10,000 inhabitants.

Keywords: water sanitation program, primary treatment, high rate sedimentation, per capita cost.

Introduction

With 6 million inhabitants, Antioquia is one of the most populated and economically active regions of Colombia (accounting for 13% of the country's population and 15% of its national GDP). Eastern Antioquia region in turn has a population of 560,000 people, which represents Antioquia's second largest after the Aburra Valley (DAP, 2010). In the last twenty years, Eastern Antioquia has experienced a strong economic development with important changes in its traditional land uses, shifting from agriculture to industrial production, commerce and residential uses. These changes not only have increased the pressure over natural resources but also have negatively impacted the water quality of several streams due to uncontrolled waste disposals. To face the issue of achieving regional competitiveness with environmental sustainability CORNARE, the local environmental authority, developed a water sanitation program for the region (Cornare, 2009), that strategically prioritizes sewage coverage and wastewater primary treatment. The program uses the principles of gradualism and flexibility to build better regional, institutional and technological capacities. This work evaluates the application of CORNARE's water sanitation program during the period 1995–2010 to identify its strengths and weaknesses in providing adequate sanitation services in the region.

Methods

Within the strategy of gradualism, CORNARE considers the construction of combined sewer collectors and integrates new systems with existing ones. CORNARE also has promoted the use of high-rate primary sedimentation and anaerobic digester of primary sludge as primary treatments. Some plants additionally use waste stabilization ponds or anaerobic filters as secondary treatment. Figure 1 shows the flow diagram of the different technologies used. The total investment in the 15 years of development of the water sanitation program amounts to US\$ 11 million. The program has provided sewer coverage and sewage primary treatment to a population of 255,000 inhabitants, resulting in an average cost of US\$ 43 per capita.

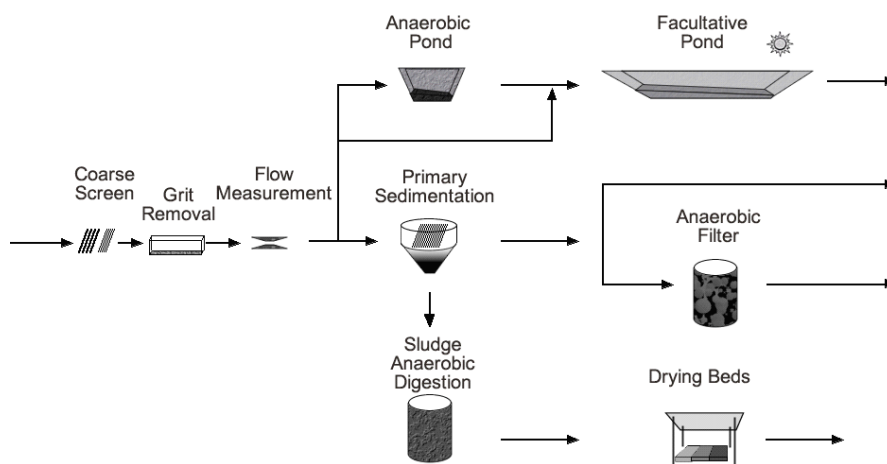


Figure 1. Flow diagram of technologies.

Results and discussion

Our analysis focuses on preliminary treatment, high-rate primary sedimentation and anaerobic digester of primary sludge. Table 1 shows the main data of 11 primary wastewater facilities located in the region. It can be seen that costs per capita for primary wastewater treatment facilities vary widely between US\$ 18.4 and US\$ 89.5 for different municipalities, whereas the wastewater treatment performances for BOD5 and TSS vary slightly between 50 and 65%. The economies of scale can be seen in the relationship between costs per capita and population (Figure 2), where sewage collectors and wastewater treatment construction costs per capita for small urban areas (less than 5,000 inhabitants), almost doubles the costs per capita of populations over 10,000 inhabitants. In addition, significant deviations have been reported in the direct construction costs for wastewater collection and treatment depending on local factors (Quintero et. al., 2007).

Table 1. Basic data of primary wastewater treatment facilities, 2009.

Municipality	Population	Coverage wastewater collection and treatment (%)	Construction cost (thousand U.S. dollar)	Cost (US dollar/ per capita)	Performance (%)	
					BDO ₅	TSS
Carmen de V.	30,000	95	553	18.4	51	50
Marinilla	20,000	95	418	20.9	52	52
El Peñol	13,050	97	306	23.5	60	60
El Santuario	19,300	95	472	24.5	62	63
Cocorná	5,806	85	159	27.5	50	53
Guarne	11,900	100	424	35.6	67	64
San Luís	9,860	70	424	43.0	67	67
San Carlos	9,000	96	394	43.8	*	*
Alejandria	3,400	95	246	72.5	53	69
Puerto Triunfo	3,425	95	272	79.5	53	59
San Francisco	1,900	95	170	89.5	52	54

* In process of performance improvement

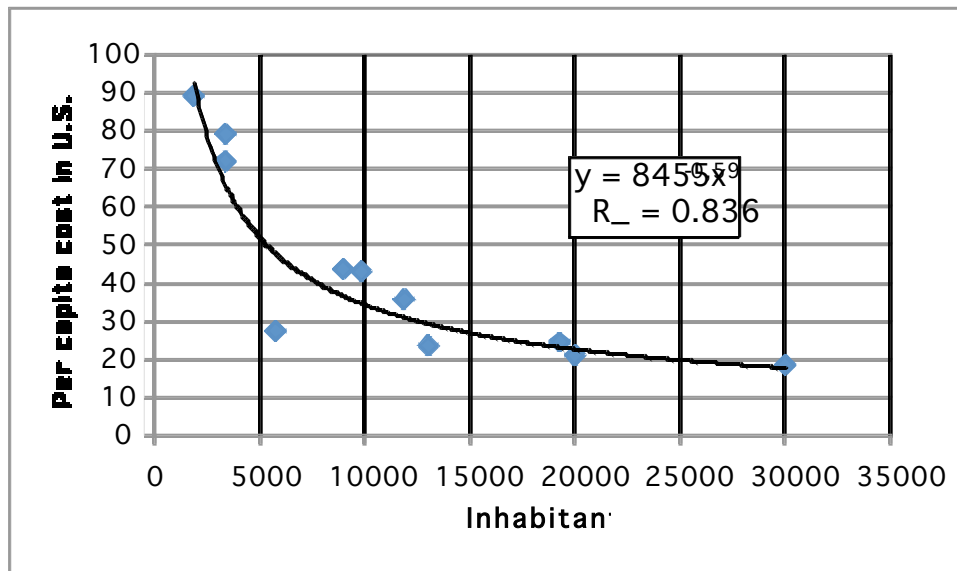


Figure 2. Cost per capita of primary treatment versus population size.

Our evaluation shows that the implementation of the water sanitation model was successful in:

- developing comprehensive sewage collection-preliminary-primary treatment of wastewater projects,
- optimizing the design and operation of wastewater primary treatments using high sedimentation rate methods, and
- strengthening institutional development and technical support at local and regional scales.

On the other hand, the model has faced some difficulties related to the design and operation of the sewage and treatment systems, like:

- the inadequate location of some treatment facilities in flooding areas,
- the clogging of combined sewer collector pipes due to sand and sediment transport from unpaved roads,
- technical and administrative deficits in the municipal utilities that create difficulties in the operation and maintenance of the systems, and
- the lack of a clear policy for biosolids management.

Conclusions

Our evaluation shows that the wastewater primary treatment facilities show sewage treatment performances for TSS and BOD5 between 50 to 65%. Due to economies of scale, the use of primary treatment systems based on high-rate primary sedimentation has optimum values for populations over 10,000 inhabitants. The design and construction of wastewater secondary treatments must be carefully planned in the immediate future, considering for instance the use of an experimental treatment plant in order to optimize resources and select the most appropriate technologies for the region.

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