Helpdesk Report

K4D Knowledge, evidence and learning for development

Small town water supply infrastructure costs

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Question

What are the construction costs for urban water supply infrastructure in small/medium towns (population 10,000 to 40,000) in Africa, including costs per capita for water supply systems and unit costs of key water supply infrastructure items?

Contents

1. Executive summary

The capital costs of water supply infrastructure vary widely both on a per-capita basis for water supply systems and on a per-unit basis for specific infrastructure items. Examples of capital expenditure per capita for some water supply systems were found to vary by as much as 19-fold within a single country (for mechanised boreholes in Ghana), and unit costs of water supply system components varied by more than 4-fold (for boreholes with hand pumps in Ghana).

Figures 1 and 2 below show the range of per-capita and per-unit costs for the countries and items where the most data were available (Ghana was the country with the most data available). The boxes represent the second and third quartiles of the range of costs, the 'whiskers' above and below the boxes represent the maximum and minimum ranges, and the dots, if any, show extreme outlying values. The complete data are shown in tables 1 and 2, which appear later in this report.

Figure 1: Range of capex per capita for three water supply systems

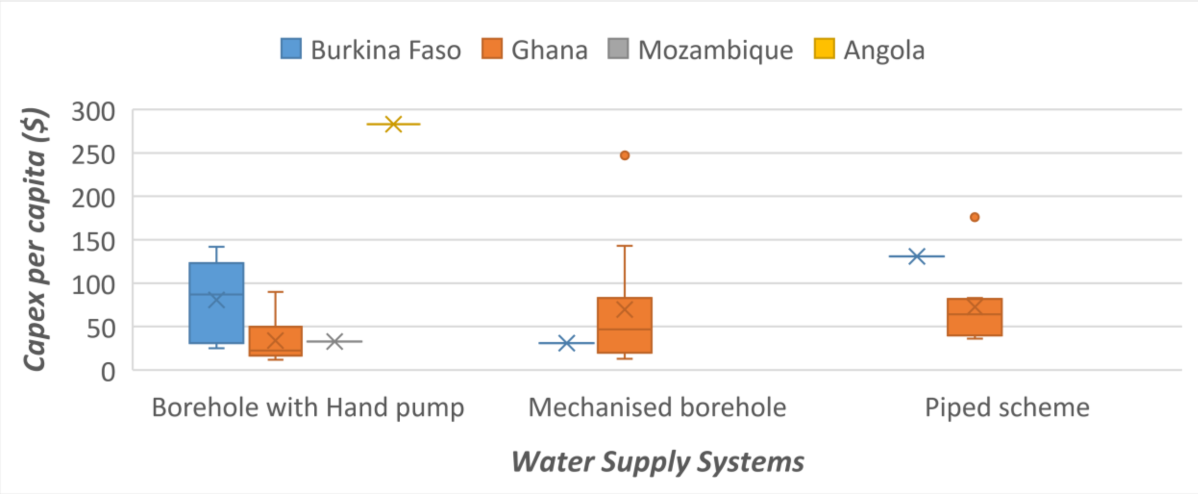
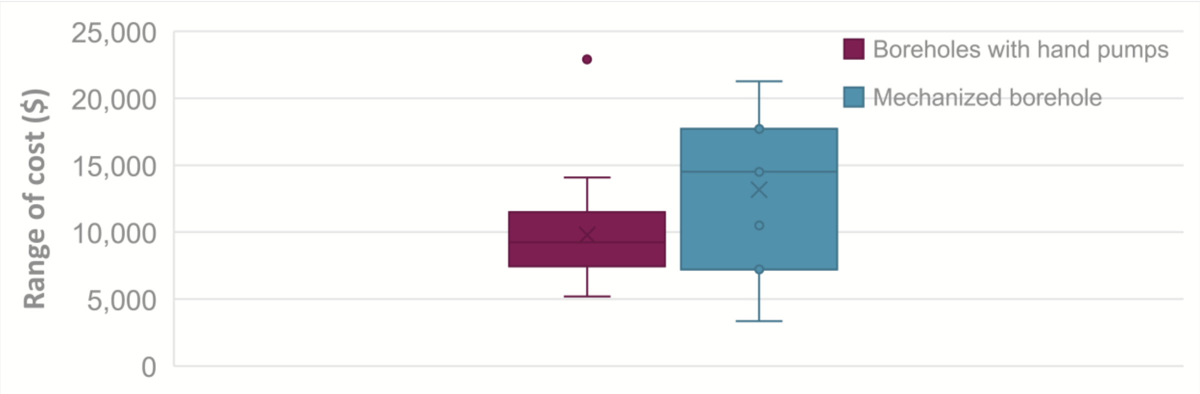


Figure 2: Range of costs for mechanized boreholes and boreholes with hand pumps



We found very limited data on the effect of different contracting mechanisms on costs, but one study in Ghana showed that national competitive bidding was associated with lower construction costs than international competitive bidding. (IRC 2012b)

2. Factors influencing infrastructure cost

The variety of organisations involved in construction of water infrastructure and their backgrounds makes it hard to compare the construction costs across the continent.

A common financial measure which is used to compare costs across countries is capital expenditure, known as capex, which is the invested capital for constructing assets, such as pumps and pipes (Fonseca *et al.*, 2010). 'Software' capex refers to one-off work with stakeholders before construction or implementation, while and 'Hardware' capex refers to the construction of physical assets (Fonseca *et al.*, 2010). Capex does not include operation and maintenance costs.

IRC (2012b) identified three major factors influencing the costs of small town water systems in Ghana:

1. Population density, showing the dispersion of users of the water system,
2. Types of technology for water storage and energy, and
3. Contract packaging.

The IRC study concluded that capex of water systems is more sensitive to pipe length per capita, a proxy for population density, than to the population alone, and that water systems contracted under international competitive bidding were reported to be more costly than those contracted under national or local competition (IRC, 2012b). It also found that in Ghana, water systems that use solar energy as a power source and steel storage facilities are significantly more costly than those with national grid power connections and concrete storage facilities. (IRC 2012b, p. 11)

In our review of the literature, we were only able to identify information about types of technology for water storage and energy (see sections 3 and 4). None of the reports that we were able to find presented information about population density or about the area covered by each project. We were able to identify information about contract packaging in only a very small number of cases, which are presented in Section 0.

One other factor that influences costs is the ground condition, which affects the costs associated with drilling/digging processes. Unfortunately no data on the ground and geotechnical condition encountered in projects was found within the literature. Burr et al. (2012) found a relationship between borehole depth and capex (for example, mean capex per borehole ranged from US$5,788 for a 31 m borehole to US$12,779 for a 55 m borehole), but borehole depth is not normally reported. Project duration can also have impact on the cost; this is reported in this report where data were available.

Burr and Fonseca (2013) reported large differences between the number of design users and actual users of water systems (varying in one case by up to 30%), and between contracted and actual costs (in one region in Ghana, the maximum average *contracted* cost of a system using boreholes with hand pumps was US$9,223 while the average field data showed *actual* costs of US$16,936).

In this report all costs extracted from the literature are converted to US$. Total project costs used to derive some of the capex per capita values are presented in Appendix A. The review includes data from publications published after 2010 written in English; some examples of additional (older) data not considered in the report are presented in Appendix B.

3. Per capita costs

Capex per capita values and details of water supply projects, including project start and finish dates, region, population, types of storage, water sources and energy are presented below, where available.

Table 1: Per capita costs of water systems

(Values from the source material are shown in normal type; values calculated by the author are shown in bold)

Country	*Source*	*Project years*	**Region / City**	**Popu-lation**	**Types of Technology**			*Capex Per Capita ($)*	*Notes*
					Water Storage	*Water Source*	*Energy Source*		
Angola	(Bain *et al.*, 2013)	2010	Urban			Piped on premises		283	1
Burkina Faso	(Pezon, 2015)	2011	Sahel Region / Mansila	7,404	-	Small piped scheme	-	131	2
						Hand pump		104	
	(Burr and Fonseca, 2013)	2010-2011	Centre	-	-	Borehole with hand pumps		87	3
			Hauts-Bassins					31	
			Nord					142	
	(Burr *et al.*, 2012)	1997-2009	Centre	5,001-15,000	-	Boreholes with hand pumps	-	87	4
			Hauts-Bassins					31	
			Nord					142	
			For all three			Boreholes with hand pumps and piped systems	-	25	1
						Mechanised borehole	-	31	
						Exclusively boreholes with hand pumps	-	78	

Country	Source	Project years	Region / City	Popu-lation	Types of Technology			Capex Per Capita ($)	Notes
					Water Storage	*Water Source*	*Energy Source*		
Central African Republic	(The World Bank, 2017)	Appraisal	Bambari	40,000	Rehabilitation of the pumping station with installation of new pumps at its original location to restore original capacity of 250 m^3/hour.	Replacement of electromechanical equipment of the water treatment plant. Minor public works to rehabilitate the plant & surroundings. Replacement of the conveyor pipeline from the station. Rehabilitation of the 1,200 m^3 storage tank. Extension of access through up to 300 individual connections as well as rehabilitation/construction of up to 60 public stand posts. Allocations for consumables to ensure uninterrupted operation of the treatment plant (chemicals, fuels for backup generators).	Grid and Backup energy use	**55**	
Ghana	(Ristinmaa *et al.*, 2013)	Appraisal	Volta region	11,493	200m^3 Concrete Storage tank	17,574m pipeline		**51**	
	(Burr and Fonseca, 2013)	2010-2011	Ashanti			Boreholes with hand pumps		18-12	[3,5]
			Northern					25-16	
			Volta					31-20	
	(IRC, 2012b)	2010	Northern	2,000 - 50,000	Steel storage facilities	Mechanized Borehole	Grid connections	83	[1]
							Solar power	143	
			Ashanti		-		Grid Connections	76	

Country	Source	Project years	Region / City	Popu-lation	Types of Technology			Capex Per Capita ($)	Notes
					Water Storage	Water Source	Energy Source		
							Solar power	247	
			Volta		-		Grid Connections	20	
	(Appiah-Effah *et al.*, 2011)	2009	Ashanti region	Small town (5,462)		Piped water system		79	[6]
	(Braimah *et al.*, 2010)	2008		Rural and small town		Piped water System		40	[7]
	(Nyarko *et al.*, 2010)	Up to 2008	Northern (N=2) Ashanti (N=1) Volta (N=1) Greater Accra (N=1) Central (N=12)	Small towns	-	Small town piped systems	-	40-176 (83)	[7]
	Burr *et al.*, 2012)	2008	NA	20,000		Single-town Piped water network (N=1)	-	36	[4]
		2007	NA	20,000	-	Multi-town Piped water network (N=2)	-	77	
	(Ristinmaa, 2012)	2006	Northern	10,762	Steel	Mechanized borehole	Grid	**54**	[8]
				11,493				**41**	
				11,441				**47**	

Country	Source	Project years	Region / City	Popu-lation	Types of Technology			Capex Per Capita ($)	Notes
					Water Storage	Water Source	Energy Source		
			Ashanti	19,477	Concrete & Steel tanks	Mechanized borehole	Grid	**13**	
	(Burr and Fonseca, 2013)	2006	-	>15,000	-	Reticulated supply with pumping, storage and distribution through public stand posts with provision for house connections.	-	36	3
		2005				Reticulated supply with pumping, storage and distribution supplied to a number of interconnected towns or villages, each with its own storage and distribution network.		77	3
	(Dwumfour-Asare, 2009)	2005 (7 months)	Pantang Area	12,758	Reservoir (150m^3 RC) Fill & Draw System	Borehole (N=1)	-	56.2	9
	(Ristinmaa, 2012)	2003	Volta	15,942	Concrete tank	Mechanized borehole	Grid	18	9
	(GWCL, 2018)		Berekum	62,364		-Drilling and mechanization of boreholes (506,000 gallons per day), -Supply and laying of 8.52km transmission and 19.62km distribution pipeline and -Construction of 41 No. standpipes.		**25**	
	(IRC, 2012a)	1998	Central/ Aboransa	10,784		Borehole	Diesel generator set	85	
	(Asante, 2010)	1998	Central	10,784	-	Borehole	Diesel generator set	90	9
	Burr *et al.*, 2012)	NA	Ashanti		-	Boreholes with hand pumps: Drilling & construction incl. platforms	-	18-12	4
			Northern		-		-	25-16	

Country	Source	Project years	Region / City	Popu-lation	Types of Technology			Capex Per Capita ($)	Notes
					Water Storage	Water Source	Energy Source		
			Volta		-		-	31-20	
Kenya	(Batchelor *et al.*, 2011)	-				Rainwater Harvesting Sand dam (1750m^3)		6	10
Mozambique	(Bain *et al.*, 2013)	2010	Urban			Piped on premises		24	1
	Burr *et al.*, 2012)	NA	NA	-	-	Boreholes with hand pumps (N=4,000)	-	33	
				5,000-15,000	-	Single-village/town networks	-	30-380	1,11
				17,000	-		-	87	1
	(Burr and Fonseca, 2013)	NA	Cabo Delgado, Gaza, Inhambane, Manica, Nampula, Niassa, Sofala, Tete, Zambézia			Boreholes with hand pumps		33	3
			NA	>15,000		Reticulated supply with pumping, storage and distribution through public stand posts with provision for house connections.		87	3
Uganda	(Batchelor *et al.*, 2011)	-				Rainwater Harvesting		45.7	10
South Africa	(Batchelor *et al.*, 2011)	-			Urban yard tank (low pressure)			535	10.12

Country	Source	Project years	Region / City	Popu-lation	Types of Technology			Capex Per Capita ($)	Notes
					Water Storage	Water Source	Energy Source		
					Urban roof tank (medium pressure)			645	
					Urban household connections (full pressure)			725	
South Africa	(Moriarty *et al.*, 2011)	-	-	Urban	Yard tank (low pressure)	-	-	301	12,13
					Roof tank (medium pressure)			363	
					Piped water & house Connection (full pressure)			410	
lower-income countries	(Fonseca, 2014) **Based on the literature**	2001-2010	-	-	-	High cost tech. Urban water supply	-	319	14
						Intermediate tech.		159	
						Peri-urban water supply (N=4)		89-193	
			Rural & peri-urban	-	-	Boreholes with hand pumps		6-53	
						Hand dug well		5-89	
						Mechanized borehole with hand pump		3-102	
						Water treatment before distribution		0-80	
						Household rain water harvesting		16-167	

Country	Source	Project years	Region / City	Popu-lation	Types of Technology			Capex Per Capita ($)	Notes
					Water Storage	Water Source	Energy Source		
						Shallow well with hand pump		12-216	
						Small piped system		47-130	
						Medium piped system		30-267	
						Large spring development		11-1363	
						Peri-urban water		89-184	
Developing countries	(Bain *et al.*, 2013)	2010	Urban	-	-	Piped on premises	-	218	1
						Standpipe		93	
						Borehole		108	
						Other (Incl. rainwater harvesting, protected wells and protected springs.)		46	

[1]Average (US$; 2010), [2]Per user (US$; 2011), [3]Per user (US$; 2010), [4]Average per **user** (not per capita) with user numbers ranging between 100 - 300 (US$; 2010), [5]values vary by number of users as per design to observed, [6]US$ 2009, [7]Average (US$; 2008), [8]Original value in GHc 2011 (converted at a 1.64 US$/GHc Rate), [9]Original value in Ghc 2008 (converted at a 0.964 US$/GHc Rate), [10]US$ PPP 2008, [11]Hardware cost only, [12]Per household, [13]Original value in Euros 2011 (converted at a 0.773 US$/Euro Rate), [14]US$; 2011

4. Unit costs of infrastructure items

Unit costs of some water infrastructure system components are reported in Table 2.

Table 2: Unit costs of key infrastructure

Infrastructure components	*Sub-components*	Source	*Country*	*Range of costs ($)*	Average cost by country ($/unit)	Average cost ($/unit)
Boreholes with hand pumps	Overall costs	(Burr *et al.*, 2012)	Burkina Faso	13,000	12,446	10,223
				10,677		
				13,588		
		Burr and Fonseca, 2013)	Burkina Faso	13,183		
				10,667		
				13,558		
		(Braimah *et al.*, 2010)	Ghana	7,000	8,687	
		(Allabo, 2016)	Ghana	5,200		
		(Burr *et al.*, 2012)	Ghana	5,272		
				7,451		
				9,223		
				22,910		
				7,869		

Infrastructure components	*Sub-components*	Source	*Country*	*Range of costs ($)*	Average cost by country ($/unit)	Average cost ($/unit)
		Burr and Fonseca, 2013)	Ghana	5,272		
				7,451		
				9,223		
		Burr and Fonseca, 2013)	Mozambique	7,155	9,537	
				12,779		
				11,119		
				9,927		
				8,913		
				7,624		
				9,272		
				8,252		
				5,788		
		(Burr *et al.*, 2012)	Mozambique	7,662		
				14,078		
				12,104		

Infrastructure components	*Sub-components*	Source	*Country*	*Range of costs ($)*	Average cost by country ($/unit)	Average cost ($/unit)
				11,299		
				9,974		
				8,519		
				10,935		
				9,455		
				6,805		
	Software	(Burr *et al.*, 2012)	Mozambique	495		1,108
				1,276		
				989		
				1,406		
				1,068		
				912		
				1,667		
				1,146		
				1,016		

Infrastructure components	*Sub-components*	Source	*Country*	*Range of costs ($)*	Average cost by country ($/unit)	Average cost ($/unit)
	Drilling and construction including platforms	(Burr *et al.*, 2012)	Ghana	5,328		6,038
				6,066		
				6,721		
	Hand dug well	(Braimah *et al.*, 2010)	Ghana	3,600	3,600	3,300
		(Godfrey and Hailemichael, 2017)	Ethiopia	3,000	3,000	
	Protected dug well	(Allabo, 2016)	Ghana	1,560		1,560
	Hand pump	(Burr *et al.*, 2012)	Ghana	737		984
				1,230		
	Hydrogeological studies and supervision		Ghana	697		882
				1,066		
	Hand pump installation cost		Ghana	205		205
Mechanized borehole	Borehole site work	(Ristinmaa, 2012)	Ghana	3,383		4,399
				4,555		
				5,260		
	Borehole (N=1)	(Ristinmaa, 2012)	Ghana	21,261		12,426
				17,715		

Infrastructure components	*Sub-components*	Source	*Country*	*Range of costs ($)*	Average cost by country ($/unit)	Average cost ($/unit)
				14,511		
				10,510		
				3,350		
				7,209		
		(Allabo, 2016)		17,715		
	Pipeline (16025m)	(Ristinmaa, 2012)	Ghana	277,743		-
	Pipeline (17715m)			142,689		
	Pipeline (14885m)			225,031		
	Pipeline (6938m)			94,059		
	Pipeline (17580m)			99,485		
	Pipeline (17500m)	(Ristinmaa *et al.*, 2013)		277,770		
	Steel Storage tank (150m^3)	(Ristinmaa, 2012)	Ghana	137,956		137,936
		(Ristinmaa *et al.*, 2013)		137,915		
	Steel Storage tank (120m^3)	(Ristinmaa, 2012)		123,402		130,274
				137,145		

Infrastructure components	*Sub-components*	Source	*Country*	*Range of costs ($)*	Average cost by country ($/unit)	Average cost ($/unit)
	Steel Storage tank (2780m³) (50' dia. × 50' ht.)`	(USAID, 2012)	Liberia	550,000		550,000
	Concrete Storage tank (100m³)	(Ristinmaa, 2012)	Ghana	17,957		17,957
	Stand post (N=1)	(Ristinmaa, 2012)	Ghana	2,745		1,812
				1,994		
				1,728		
				1,569		
				670		
		(Ristinmaa *et al.*, 2013)		2,166		
Solar-powered water pumps	Medium–High total dynamic head (TDH) Medium–low flow	(Oxfam, 2018)	Kenya	41,105		41,105
	Low total dynamic head High flow			105,011		105,011
	Solar pump	(USAID, 2012)	Liberia	2,000		2,000
	Stand and Foundation for Panels		Liberia	2,000		2,000
	Fencing		Liberia	1,500		1,500
Treatment Plant	Package Treatment Plant	(USAID, 2012)	Liberia	170,000		170,000
	Generators		Liberia	5,000		5,000

Infrastructure components	*Sub-components*	Source	*Country*	*Range of costs ($)*	Average cost by country ($/unit)	Average cost ($/unit)
Intake Pumps & Controls	125 gpm @ 60'TDH -Intake Structure Building & Components	(USAID, 2012)	Liberia	30,000		30,000
Power sources	Diesel Generator Set (80 KVA, Diesel fuelled and accessories)	(USAID, 2012)	Liberia	180,000		180,000
	Solar Power System, Solar Array, battery storage and controls (80 KVA)		Liberia	2,200,000		2,200,000
Reservoir	Concrete (200 m^3)	(Ristinmaa *et al.*, 2013)	Ghana	90,415		90,415
Rainwater Harvesting	Sand dam (400 m^3)	(Batchelor *et al.*, 2011)	Ethiopia	12,144		12,144
	Sand dam (1750 m^3)		Kenya	17,966		17,966
	Ferrocement jar (13.6 m^3)		Mali	1,388		1,388

5. Contracting mechanisms

In this review we were not able to find details about the effects of contracting mechanisms on costs. The contracting mechanism used was specified in only two articles, which are presented in Table 3. The IRC (2012b) report on water systems in Ghana shows that in that country, national competitive bidding was associated with lower costs compared with International competitive bidding, but we are not able to confirm whether this is the case in other countries.

Table 3: Costs per capita based for different types of contracts

Source	Type of Contract	Types of Technology			*Capex Per Capita ($)*	*Average Capex per capita ($)*
		Water Storage	Water Source	Energy		
(IRC, 2012b)	International competitive bidding	Steel storage facilities	Borehole	Grid connections	83	119
				Solar power	143	
	International competitive bidding				130	
	National competitive bidding				49	35
	National competitive bidding			Grid Connections	20	
(The World Bank, 2017)	Open National		Mainly rehabilitation	Grid and Backup energy use	**55**	**55**

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Appendix A: Projects examined

The overall costs of various water system, as reported within the reviewed literature, are presented in Table 4.

Table 4: Overall cost of various water systems

Source	*Country*	Region / City	Population	Types of Technology			Overall capex	Notes
				Water Storage	Water Source	Energy		
(Nyarko *et al.*, 2010)	Ghana	Northern Ashanti Volta Greater Accra Central	Small towns	-	Small town piped systems	-	136,100 - 1,151,350	1
(Burr *et al.*, 2012)	Ghana	2008	20,000	-	Single-town Piped water network (N=1)	-	19,477	2
		2007			Multi-town Piped water network (N=2)	-	19,820	
(Ristinmaa, 2012)	Ghana	Northern	10,762	Steel	Mechanized borehole	Grid	585,822	3
			11,493				468107	
			11,441				542,575	
		Volta	15,942	Concrete tank	Mechanized borehole	Grid	292,178	
		Ashanti	19,477	Concrete & Steel tanks	Mechanized borehole	Grid	261,833	
(Burr and Fonseca, 2013)	Ghana		>15,000		Reticulated supply with pumping, storage and distribution through public stand posts with provision for house connections.		19,477 - 19,820	4
(Appiah-Effah *et al.*, 2011)	Ghana	Ashanti region	Small town (5,462)		Piped water system		429,151	5

			15,584				781,847	
(The World Bank, 2017)	Central African Republic	Bambari	40,000		Rehabilitation of a pumping station & storage tank with installation of new pumps, replacement of electromechanical equipment of the water treatment plant and Minor public works	Grid and Backup energy	2,200,000	
(Ristinmaa *et al.*, 2013)	Ghana	Volta region	11,493	200m^3 Storage tank	17,574m pipeline		586,056	3
(GWCL, 2018)	Ghana	Berekum	62,364		Drilling and mechanization of boreholes (506,000 gallons per day), Supply and laying of 8.52km transmission and 19.62km distribution pipeline and Construction of 41 standpipes.		1,588,320	6
		Nsawam	44,522 (2013)		Construction of a new 1.7 million per day treatment plant and distribution improvement works.		13,180,000	
(USAID, 2012)	Liberia	-	19,600	-	Restore Water Distribution System to serve all areas		16,245,000	

[1]US$; 2008, [2]Mean service area size (US$ 2010), [3]Original value in Ghc 2011 (converted at a 1.64 US$/GHc Rate), [4]US$; 2010, [5]US$ 2009, [6]Original value in Euros (converted at a 0.89 US$/Euro Rate)

Appendix B: Additional data not included in the report

Additional data from the literature which did not meet the criteria for inclusion in this study are presented here; this primarily consists of data for projects undertaken before 2010.

Table 5: Out of date data for costs in Africa (per capita) for different supply systems, source (Hutton and Bartram, 2008)

Per capita costs of water and sanitation improvements, excluding programme costs

	Per capita costs (US$ year 2005[a])					
	Initial investment cost			Annual recurrent cost		
Improvement type	Africa	Asia	LAC	Africa	Asia	LAC
Water improvement						
Household connection (treated)	164	148	232	13.4	9.6	14.6
Standpost	50	103	66	0.5	1.0	0.7
Borehole	37	27	89	0.2	0.2	0.6
Dug well	34	35	77	0.2	0.2	0.5
Rainwater	79	55	58	0.5	0.4	0.4
Average of non-household connection options	50	55	72	0.4	0.5	0.5
Sanitation improvement						
Household connection (partial treatment)	193	248	258	8.2	9.1	11.0
Septic tank	185	167	258	6.2	6.1	6.8
Pour-flush	147	81	97	6.1	5.5	5.7
VIP	92	81	84	3.8	3.8	3.8
Simple pit latrine	63	42	97	3.6	3.5	3.9
Average of non-household connection options	122	93	134	4.9	4.7	5.0

LAC, Latin America and the Caribbean

[a] Data from 2000 adjusted to 2005 prices using an average annual gross domestic product (GDP) deflator of 10%.

Costs of water systems in Africa are listed by McGinnis *et al.* (2017; Table 3), however the utilised information did not meet the main criteria adopted in this study (population and being published after 2010).

Table 6: PVC pipes prices in GHc, source Dwumfour-Asare (2009)

Table 5A.4: Example of prices of PVC pipes

PVC pipes (class C) *Diameter by pipe length*	2004	2005	2006	2007	2008
200mm or 8"X 6m	104.81	120.50	132.58	144.70	173.65
150mm or 6" X 6m	68.74	79.00	83.10	87:00	104.40
100mm or 4" X 6m	32.08	35.89	38.76	40.60	48.71
NB: Prices are the Ex-factory prices including VAT+NHIL in GH¢					

Source: Interplast Ltd. Accra.

Table 7: Cost per item as percentage of the overall costs, source Dwumfour-Asare (2009)

Level of Disaggregation		Pantang WSS
Level 1	Level 2	
Hardware cost	Items	
	General items	3.46
	Pumps, installation & control panel	7.2
	Pipelines (Trans. & Dist.) works	45.59
	Treatment plant(s)	0
	Reservoir(s)	9.01
	Public Standpipes	2.39
	Borehole(s) or alternative water source works	2.89
	Watson Board House	2.97

Table 8: Estimated and actual drilling costs, older than 2010, source Danert *et al.* (2009)

Country, year (ref)	Cost/Price per:		Description
	well	meter	
Burkina Faso 2006 (ANTEA 2007)		$152	Average cost of drilling and installation of casing and screen (PVC) but not the pump, as established by study of drilling costs.
Chad 2005 (Practica, 2005)	$12,000 - 15,000		Range of machine drilled well prices paid by different agencies.
Ethiopia, 2005 (Carter, 2006)	$37,800	$252	Estimated price for a 200 mm diameter, steel cased borehole to 150m. No pump or supervision (based on analysis of inputs).
Kenya, 1996 (Doyen, 2003)	$8,400	$120	Price estimated for 70m well in specific programme (includes drilling, testing but not siting, supervision or failure)
Malawi, 2001 (Mthunzi, 2004)	$2,730	-	Estimated average well cost including capital, recurrent, personnel & materials; assuming 45 wells per year with small rig by NGO.
Niger, 2005 (Danert, 2005)	$10,000	$160	Estimated price on a bill of quantities, 60m depth, 700km from capital city, excluding supervision and pump installation
Mozambique, 2006 (WE Consult, 2006)		$151	Average drilling price according to the report. Includes siting, pump installation and VAT.
Nigeria, 2006 (Adekile, 2007)	$11,700	$195	Federal Ministry of Water Resources 2006 borehole price. PVC lined, 60 m depth fitted with handpump.
Nigeria, 2008 (Adekile et al, 2008a)	$6,000	$120	Estimated price for a 110mm diameter, PVC lined borehole to 50m depth without pump or supervision (based on analysis of inputs).
Nigeria, 2008 (Adekile et al, 2008a)	$2,140	-	Hand drilled, 110 mm, PVC lined.
Senegal, 2006 (ANTEA, 2007)	-	$500	Average cost of drilling and installation of casing and screen (stainless steel) but not the pump, as established by study.
Tanzania, 2004 (Baumann, 2005)	$6,000	-	Budget for borehole with a handpump, as in the National Rural Water Supply and Sanitation Programme (2004), Main Report V 1.
Uganda, 2007 (MWE, 2007)	$8,700	-	Average price of private sector drilled deep boreholes (with handpumps) paid for by district local governments in F/Y 2006/7.
Nigeria, 2008 (Adekile et al, 2009)	$500,000	$2,500	Contract price for 200 m borehole in River State

Table 9: Details of borehole costs for larger cities (over 100,000 population) in Kenya, source (Alexander *et al.*, 2016)

Setting up a school WASH program: Capital Hardware costs, Kenya 2014.

Item	Unit Cost of Item	Average Cost per School per Year	Average Cost per Student per Year
Total cost, divided by ten years	USD (KES)	USD (KES)	USD (KES)
Borehole	9529 (850,000)	953 (85,000)	2.38 (212)
Two 10,000 L water tanks	2690 (240,000)	369 (24,000)	0.67 (60)
Two 25,000 L water tanks	6726 (600,000)	673 (60,000)	1.68 (150)
Gutters for collecting rain water	202 (18,000)	20 (1800)	0.05 (4.5)
VIP latrine: 4 doors	8965 (800,000)	897 (80,000)	2.24 (200)
Sub-total borehole and VIP	18,500 (1,650,000)	1850 (165,000)	4.62 (412.50)
Sub-total rainwater system and VIP	18,590 (1,658,000)	1859 (165,800)	4.65 (414.50)
Total cost, divided by three years			
Handwashing vessels	224 (20,000)	75 (6667)	0.19 (16.7)
Drinking water vessels	90 (8000)	30 (2667)	0.07 (6.7)
Water vessel for menstrual hygiene	12 (1000)	4 (333)	0.01 (0.8)
Sub-total	326 (29,000)	108 (9667)	0.27 (24.2)
TOTAL (higher cost of rainwater system)	18,916 (1,681,422)	1967 (175,467)	4.92 (439)

Table 10: Price per unit for larger cities (with over 1m population), source Luengo *et al.* (2010)

Country	Largest city	HH connection (US$/m3)*	Small piped network (US$/m3)	Standpipe (US$/m3)	HH reseller (US$/m3)	Water tanker (US$/m3)	Water vendor (US$/m3)
Benin	Cotonou	0.41	N/A	1.91	1.91	N/A	N/A
Burkina Faso	Ouagadougou	0.90	N/A	0.48	N/A	N/A	1.67
Ethiopia	Addis Ababa	0.19	N/A	0.87	1.44	3.85	N/V
Mozambique	Maputo	0.96	0.98	0.98	0.98	N/A	N/V
Niger	Niamey	0.52	N/A	0.48	N/A	N/A	1.79
Nigeria	Kaduna	0.17	N/A	N/V	N/V	3.43	5.71
Rwanda	Kigali	0.44	N/A	1.79	1.79	4.48	N/A
Senegal	Dakar	0.37	N/A	1.53	N/V	N/A	2.29
South Africa	Johannesburg	0.05	N/A	N/A	N/A	N/V	N/V
DRC	Kinshasa	0.05	2.11	1.02	1.01	N/A	N/A
Ghana	Accra	0.52	N/A	5.51	1.53	5.46	6.89
Kenya	Nairobi	0.18	0.60	1.73	N/A	3.74	3.47
Lesotho	Maseru	0.40	N/A	2.58	N/V	N/V	N/V
Malawi	Blantyre	0.12	N/A	1.16	3.38	N/A	N/A
Namibia	Windhoek	1.45	N/A	N/A	N/A	N/A	N/A
Sudan	Great Khartoum	0.37	N/A	1.15	N/V	4.32	3.00
Zambia	Lusaka	0.56	N/A	1.67	N/V	N/A	3.00
Cape Verde	Praia	2.67	N/A	9.44	N/A	9.67	11.38
Chad	N'Djamena	0.22	N/V	N/V	N/V	N/A	N/V
Cote d'Ivoire	Abidjan	0.04	N/V	0.93	1.82	N/A	3.35
Madagascar	Antananarivo	0.11	0.47	1.24	N/V	N/A	2.33
Tanzania	Dar es Salaam	0.39	N/V	0.87	0.98	2.40	2.56
Uganda	Kampala	0.25	N/A	1.40	1.40	N/V	4.50
	Average	0.49	1.04	1.93	1.63	4.67	4.00
	Median	0.37	0.79	1.24	1.49	4.08	3.00
	Min	0.04	0.47	0.48	0.98	2.40	1.67
	Max	2.67	2.11	9.44	3.38	9.67	11.38
	Overprice**		2.14	3.36	4.02	11.03	8.11

** 4 m3 / month*
*** Price SSIP/HH connection*
Source: AICD WSS database, Other

Note: Data from 23 cities. Standpipe price is the "retail" otherwise referred to as informal price paid by the consumer at the tap.

Table 11: Unit costs of well and boreholes, source Banerjee and Morella (2011), not specifically for urban systems

	Borehole with hand pump ($ per capita)	*Well with hand pump ($ per capita)*
Benin	50	36
Burkina Faso	36	26
Cameroon	76	58
Cape Verde	50	36
Chad	50	36
Congo, Dem. Rep.	50	36
Côte d'Ivoire	50	36
Ethiopia	50	36
Ghana	22	20
Kenya	50	36
Lesotho	50	36
Madagascar	50	17
Malawi	50	36
Mozambique	50	36
Namibia	50	36
Niger	94	82
Nigeria	50	36
Rwanda	50	36
Senegal	50	36
South Africa	50	36
Sudan	50	36
Tanzania	50	36
Uganda	50	36
Zambia	50	36

Table 12: Out of date cost details for Tanzanian, source (Haysom, 2006)

Technology	**Capital Cost**
Lister (diesel-fuelled engine, manufactured in either the UK or South Africa)	Sh7-8 million
Mono (progressing cavity pump)	Sh15 million
Electrical Submersible (pump with electrically-powered motor next to pump below water level)	Sh8 million
Chinese DF (diesel-fuelled engine, manufactured in China)	Sh500,000 – 1 million
Chinese HZ (diesel-fuelled electricity generator manufactured in China)	Sh500,000
Borehole (depends on depth and soil type)	Sh8-15 million

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