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Costing water services in refugee camps

Camp Bambasi, Ethiopia, and Camp Kounoungou, Chad

Christelle Pezon, Kristof Bostoen, Mélanie Carrasco and Ruzica Jacimovic

Supporting water sanitation and hygiene services for life

UNHCR
The UN Refugee Agency

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This report applies the life-cycle costs approach in two refugee camps, Bambasi in Ethiopia and Kounoungou in Chad. It relies on cost data from financial reports in Geneva and in both camps, and on service-level data collected through the UNHCR monitoring system and on site through water point surveys.

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Executive summary

This report applies the life-cycle costs approach (LCCA) to the provision of water services in two UN refugee camps, Bambasi in Ethiopia and Kounoungou in Chad. It is based on cost data from financial reports in Geneva and both camps and on service-level data collected through the UNHCR monitoring system and on site through water point surveys.

The purpose of the study was (1) to better understand the structure, magnitude and drivers of the cost of providing a targeted level of water service to refugees, and (2) to reflect on the applicability of LCCA in the UNHCR monitoring framework and the potential for implementing it in systematically.

The study faced various challenges. Not all the required financial data were available for Camp Kounoungou, and determining the volume of water used and the refugee population in both camps—two essential elements for calculating unit costs—proved difficult. A comparison of data reported to UNHCR with the data collected on site by IRC revealed gaps in the existing monitoring system.

A service "ladder"—indicating levels of service—allows assessment of the service as designed, the service reported and the service actually received. In Camp Bambasi, the level of service per design is above standard. As reported to UNHCR, the service was acceptable in 2013 but fell to problematic in 2014 because of water quality problems. In Kounoungou, the level of service per design has been above standard in most years. As reported to UNHCR, the service was mainly problematic because of insufficient quantity until system extensions improved the volume and proximity of water of taps to households.

In both camps, however, the actual levels of service are lower than those reported to UNHCR. Nevertheless, even the observed water service in these two camps is good when compared with that in regular settlements in Africa. Overall, in Bambasi 21% of the refugees received an acceptable or above-standard water service, and in Kounoungou 36% received an acceptable service. In rural Africa generally, 80% to 100% of the population receives only a critical level of service.

The report provides insights on the cost of water in emergency versus permanent situations. For example, in Bambasi 44 months of operating the emergency system equals the investment in the permanent system. Thus, investment in a permanent system is justified if this camp operates longer than 3.6 years.

The use of unit costs, whether per capita or per cubic meter (m3) of water, is revealing. The pipe scheme in Bambasi cost twice as much to build as the system in Kounoungou, but because it was designed to supply a population twice what was registered in 2014, the investment per capita is four times higher. The number of users also affects per capita operational costs and, in an exit strategy, the amount of any tariff that UNHCR might impose. For UNHCR to recover the costs of operation and management, a refugee in Bambasi would have to contribute, per year, $8 based on the reported population but $12 based on the observed population; the comparable figures for Kounoungou are $2.35 and $6.80.

Combining service levels and unit costs shows that compared with refugees in Bambasi, refugees in Kounoungou receive, on average, a better and less expensive water service.

Findings of the report cannot be used as benchmarks but do provide first figures that must be put in broader perspective through similar analyses on a larger sample of camps and settlements. More accurate knowledge about water demand could inform the standards by which UNHCR specifies the quality of water service. It could indicate that the thresholds of the quality indicators should be revised, or that the level of investment required to supply enough safe water to refugees should be changed. One recommendation is to regularly monitor water demand as well as supply. Another is to apply LCCA to more camps to build benchmarks that can improve budget planning.

1 Introduction

This report presents the results from adapting and applying the life-cycle cost approach (LCCA) for costing water service to a refugee context. It helps in understanding the cost of water provision per system, per user and per cubic metre (m3) of water, and it compares the cost of providing water in both emergency and permanent situations, across camps and time, and with costs in regular settlements. An earlier report describes the methodology adapted by IRC for camps based on an approach for costing water in regular settlements[1]. This second report applies the methodology to two camps, Bambasi in Ethiopia and Kounoungou in Chad.

The analysis is based on cost data from financial reports in Geneva and both camps and on service-level data collected through the UNHCR monitoring system and on site through water point surveys.

The purpose of testing the LCCA methodology is twofold: first, to better understand the structure, magnitude and drivers of the cost of providing a targeted level of water service to refugees, and second, to reflect on the embedding of LCCA in the UNHCR monitoring framework. This testing should indicate the applicability of the LCCA to a refugee context, its added value and the potential for implementing it in a systematic manner in UNHCR.

The application of LCCA in the two camps has faced various challenges. Some critical figures for Kounoungou could not be found, and determining the volume of water and the refugee population in each camp—two essential elements for calculating unit costs—proved difficult. Water volumes and population are reported to UNHCR through WASHCards on a regular basis, but a comparison of the figures reported to UNHCR with the data collected on site by IRC revealed gaps in the existing monitoring system.

The next section (3) of the report addresses the level, or quality, of the service provided to and received by refugees in the two camps. Service levels can be measured per design, by the information reported to UNHCR and by observational data. The data reported to UNHCR mainly concern the supply side of the service (what service is offered to refugees), whereas the data collected by IRC provide information on the demand side (what service refugees actually receive). A better understanding of water demand and use could inform the standards used by UNHCR to specify service quality and may suggest different thresholds of service. Ultimately, the information could lead to more accurate estimates of the investment required to supply water of acceptable quality and quantity to refugees.

The subsequent section (4) addresses the cost of water services in the two camps. Cost per design is compared with real expenditure, and unit costs are calculated with the data reported to UNHCR (volume of water and registered camp population). These data are then compared with the data collected by IRC during the water point surveys. For Camp Bambasi, built in 2012, we compare the costs of providing water during an emergency with a more permanent situation. For Camp Kounoungou, which is 10 years old, we compare the costs of different systems across time. The costs of water provision in the two camps can also be compared with each other, as well as with water costs in regular settlements in Africa.

The final section of this report (5) synthesizes the main findings of the testing of LCCA in the two camps and provides recommendations.

[1] See methodological report: http://www.ircwash.org/news/methodology-cost-water-services-refugee-context

2 Comparing expected, reported and observed levels of service

The level of service provided to refugees is measured based on standards defined by UNHCR, in the form of four indicators: quantity, quality, distance and crowding. Together, IRC and UNHCR developed a service ladder, adapted to the refugee context, with four levels of service (Table 1):

- *Above standard.* Water service is above standard when refugees get at least 20 litres per capita per day of water that is free of coliform bacteria (for unchlorinated water) or has no more than 0.5 mg per litre of residual chlorine (chlorinated water).
- *Acceptable.* A quantity between 15 and 20 litres per capita per day qualifies as an acceptable level of service if the water is free of coliforms or has no more than 0.1 mg per litre of residual chlorine.
- *Problematic.* Between 10 and 15 litres per capita per day, the service becomes problematic.
- *Critical.* When refugees receive less than 10 litres per capita per day, the service falls to the critical level.

On this ladder, quality is as important as quantity. Supplying 50 litres per day of untested water is no better than supplying 3 litres per day of high-quality water: both levels of service are deemed critical.

Distance and crowding also affect the level of service provided. A service that is above standard in quantity and quality must be available less than 200 metres from refugees' houses, and depending on technology, used by no more than 250 people (for hand pumps and shallow wells) or 100 people (per tap at a tap stand) per day. If these conditions cannot be met, an otherwise above-standard service falls to acceptable or even critical when crowding exceeds 500 people (for hand pumps and shallow wells) or 250 people (for a tap) per day.

Table 1 Water service ladder, adapted to refugee context

INDICATOR	Quantity (l/c/d)	Quality			Distance m	Crowding	
LEVEL OF SERVICE		Unchlorinated water point	Chlorinated water point	Aggregated level of service		c / HP-SW	c/ tap
Above standard	>= 20	0 *E. coli* cfu	FRC >0.5 mg/L and NTU < 5	Quantity and quality indicators are above standards	<= 200	=< 250	=< 100
Acceptable	[15 to 20 [		0.5 mg/L>=FRC >=0.1 mg/L and NTU < 5	At least one indicator is acceptable while the other is above standard	> 200	[251-500]	[101-250]
Problematic	[10 to 15 [	>=1 *E. coli* cfu	no FCR	At least one indicator is problematic while the other is acceptable or above standard			
Critical	< 10	no test	no test	At least one indicator is critical		>500	>250

FRC = free of residual chlorine; HP = hand pump; NTU = Nephelometric Turbidity Unit; SW = shallow well

Two data sets were used to inform the ladder and identify service levels provided to a specific population in a given area: data reported to UNHCR through WASHCards and data collected by IRC through water point surveys. The former describes the level of service from a supply perspective (the quality of the service made available to refugees), whereas the latter describes the service from a demand perspective (what refugees actually receive)[2].

2.1 Service levels at Camp Bambasi, Ethiopia

Photo: Camp Bambasi, Ethiopia (IRC, 2014)

2.1.1 Expected level of service

Camp Bambasi opened in June 2012. During the emergency phase (June to December 2012), 12,133 refugees could collect water from 120 taps in a gravity system (Table 2). The system was initially supplied by water tank vehicles. From September to December 2012, water was pumped from a nearby river, and in addition, seven wells were dug by hand.

A permanent solution was implemented in January 2013. The new system, fed by the above-mentioned river, began with 278 taps. In June 2013, it was extended to supply camp institutions–the school, the medical centre and the partners' compound. In January 2014, the system was extended again to supply the nearby hosting community with 88 taps, serving 3,849 individuals based on 20 litres per capita per day.

2 See methodological report: http://www.ircwash.org/news/methodology-cost-water-services-refugee-context. See the ladder here: http://www.ircwash.org/blog/costing-water-services-humanitarian-context-setting-ladder

Table 2 Chronology of water provision and population

<table>
<tr><th>Year</th><th>Months</th><th>Type of technology</th><th>Taps</th><th>Refugees (households)</th></tr>
<tr><td rowspan="3">2012</td><td>June– August</td><td>Water tank vehicles and gravity system</td><td rowspan="2">120</td><td rowspan="3">12,133
(3,675)</td></tr>
<tr><td>September–December</td><td>Water pumped and gravity system</td></tr>
<tr><td>June– December</td><td>Hand-dug well</td><td>7</td></tr>
<tr><td rowspan="2">2013</td><td>All year</td><td>Permanent piped scheme</td><td>278</td><td rowspan="2">12,882
(3,782)</td></tr>
<tr><td>July–December</td><td>Extension on camp premises</td><td>76</td></tr>
<tr><td>2014</td><td>January–</td><td>Permanent piped scheme
Extension to hosting community</td><td>278 + 76
88</td><td>13,639
(3,849)</td></tr>
</table>

The number of taps has been sufficient to supply the entire population at all times. The crowding indicator is above UNHCR standards, with an average of only 50 refugees per tap. Considering the system's pumping capacity of more than 430 m3 per day, delivering up to 30 litres per capita per day, the water quantity indicator is above UNHCR standards. The distance and water quality indicators are also above standard. Indeed, according to the camp's allotment plan, each individual lives within 200 metres of a tap, and water treatment ensures safe supply. Altogether, 100% of the camp's population can expect above-standard service for all four indicators.

2.1.2 Data reported to UNHCR

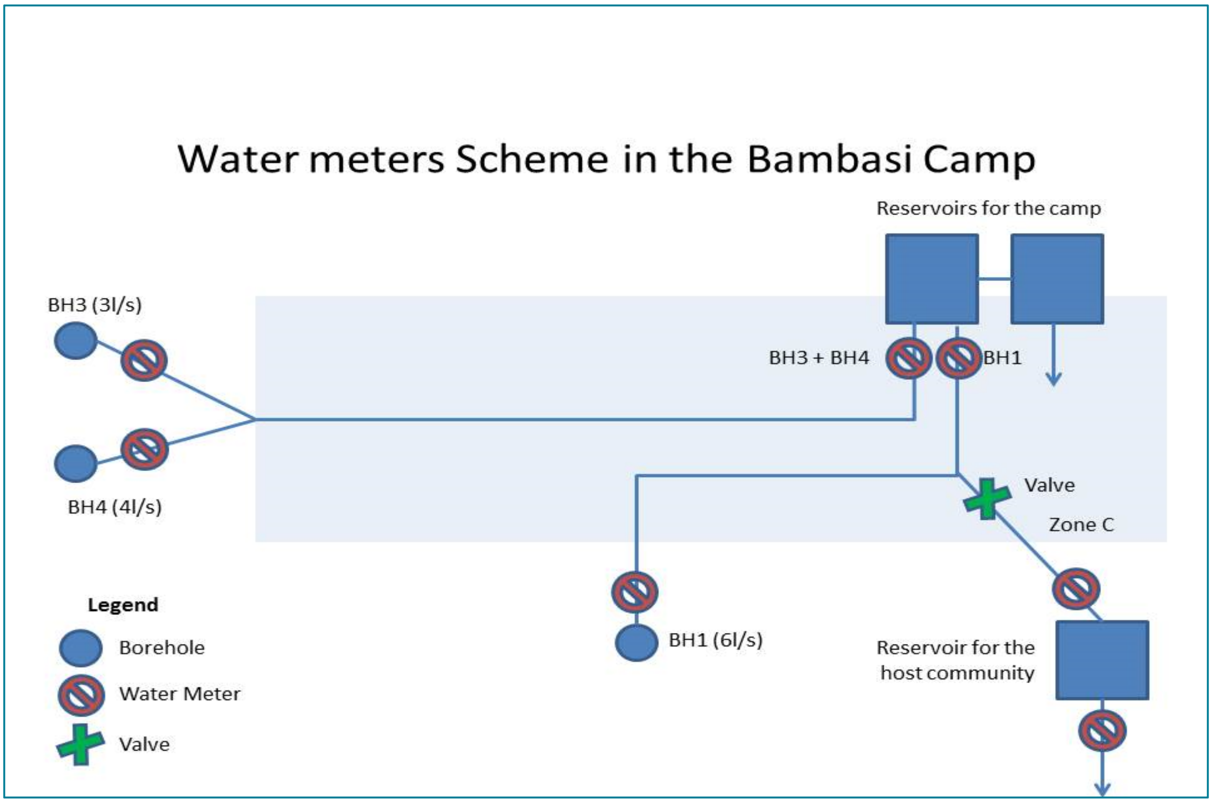
WASHCards and household surveys for 2013 and 2014 indicate that refugees were provided an above-standard service in term of quantity (litres per capita per day), distance (percentage living within 200 metres of a water point) and crowding (capites per tap) (Table 3).

Table 3 Reported service levels, by indicator

	Jul-13	Aug-13	Sep-13	Oct-13	Jan-14	Feb-14	Mar-14	Apr-14
Quantity (l/c/d)	20.1	22.3	20.1	22.2	21.0	21.0	20.3	20.3
Distance < 200 m (%)	100	100	100	100	100	100	100	100
Crowding (c/tap)	47	47	47	48	48	48	49	49

With the installation of water meters at three boreholes and at the entry of the three reservoirs in early 2014, the figures for water quantities pumped, stored and distributed could be reported based on the water meter readings (Figure 1).

Figure 1 Water meters in Camp Bambasi



However, in April 2014, the quantity pumped was still estimated based on pumping time and tank capacity, and the volume distributed was calculated based on assumptions about loss (5%) and consumption by institutional uses and INGOs (Figure 2). The reported water quantity per capita per day is obtained by dividing the estimated distributed volume by the number of refugees registered in the camp.

Figure 2 WASHCard for Camp Bambasi, June 2013 (extract)

THE LUTHERAN WORLD FEDERATION

UNHCR
The UN Refugee Agency

Water Production and Distribution Monitoring Template

Bambasi Refugee Camp

Sources Tapstands and Hand Dug Wells in the Refugee Ca

IP Name:LWF Prepared and compiled by:Alemayehu Godebo

Location: Benishangul Gumuz, Bamba Month: June 2013

SN	Days in a month	Volume of daily water production (M3)	Volume of water distributed to ARRA Health center(M3)	Volume of water distributed to Schools(M3)	Volume of water distributed to IPs(M3)	Volume of water wastage-leakge,over flow,etc(M3)	Net Volume of water distributed to the refugess(M3)
1	01-Oct-13	314.92	10		12.92	15.75	276.26
2	02-Oct-13	331.84				16.59	315.25
3	03-Oct-13	354.31			5.83	17.72	330.76
4	04-Oct-13	312.15	10			15.61	286.54
5	05-Oct-13	289.68			13.75	14.48	261.44
6	06-Oct-13	258.55			13.75	12.93	231.87
7	07-Oct-13	307.17	10		2.00	15.36	279.81
8	08-Oct-13	294.52			10.42	14.73	269.38
9	09-Oct-13	323.37			8.67	16.17	298.53
10	10-Oct-13	331.61	10		8.67	16.58	296.36
11	11-Oct-13	327.76			9.08	16.39	302.29
12	12-Oct-13	325.03			3.75	16.25	305.02
13	13-Oct-13	269.10	10		13.75	13.46	231.90
14	14-Oct-13	418.06				20.90	397.16
15	15-Oct-13	339.39			15.75	16.97	306.67
16	16-Oct-13	365.63	10		2.00	18.28	335.35
17	17-Oct-13	327.21			10.00	16.36	300.85
18	18-Oct-13	301.84			9.08	15.09	277.67
19	19-Oct-13	336.82	10		8.67	16.84	301.31
20	20-Oct-13	263.20			3.33	13.16	246.70
21	21-Oct-13	348.34			7.08	17.42	323.84
22	22-Oct-13	307.89	10		6.67	15.39	275.83
23	23-Oct-13	327.64			3.75	16.38	307.50
24	24-Oct-13	301.71			5.33	15.09	281.29
25	25-Oct-13	331.92	10		6.67	16.60	298.66
26	26-Oct-13	325.94			7.08	16.30	302.56
27	27-Oct-13	312.15	10		2.00	15.61	284.54
28	28-Oct-13	380.77			12.00	19.04	349.73
29	29-Oct-13	362.86			3.33	18.14	341.38
30	30-Oct-13	316.23	10		6.67	15.81	283.75

Distance and crowding indicators remained above standard: every household lived less than 200 metres from a tap stand, and the average crowding was around 50 visitors per tap. Distances were estimated by the WASH officer, and crowding reflects the average number of users per tap (number of refugees registered divided by total number of taps).

Water quality is tested randomly every month on three water points per zone, or nine water points throughout the camp. It is also tested as part of the household monthly survey. In 2013, WASHCards indicated that about half of existing water points delivered above-standard water quality (although the proportion had been decreasing since 2013), and the other half delivered water of acceptable quality (Table 4). At the household level, overall water quality was acceptable, although problematic for 3% of surveyed households.

Table 4 Water quality, as tested at water points and household (HH) level

		Jul-13	Aug-13	Sep-13	Oct-13
WASH Card	% Above standard (FRC>0.5 mg/l	51	47	48	41
	% Acceptable (0.5>=FRC>=0.1 mg/l)	49	53	52	59
HH Test	% Acceptable (0.5>=FRC>=0.1 mg/l)	97	97	97	97
	% Problematic (no FCR)	3	3	3	3

The WASHCards for the first three months of 2014 showed that water quality at water points had deteriorated since 2013 (Table 5). A few water points ranked above standard and some fell in the problematic category, but most chlorinated water points delivered an acceptable water quality. Critical scores were associated with unchlorinated water points (the hand pumps), but household surveys indicated these were no longer used.

Table 5 Water quality, as tested at water points

		Jan-14	Feb-14	Mar-14	Apr-14
WASH Card	% Above standard (FRC>0.5 mg/l)	7	7	11	11
	% Acceptable (0.5>=FRC>=0.1 mg/l)	73	73	85	85
	% Problematic (no FCR)	16	16	3	3
	% Critical	4	4	1	1
HH Test	% Use of chlorinated water only	100	100	100	100

Overall, in 2013 the level of service delivered in Camp Bambasi was acceptable but in 2014 became problematic with regard to quality for 3% of tested water points in March and April (Table 6).

Table 6 Reported service levels, 2013–2014

	Jul-13	Aug-13	Sep-13	Oct-13	Jan-14	Feb-14	Mar-14	Apr-14
Quantity								
Quality								
Distance								
Crowding								
Aggregated level								

Above standard   Acceptable   Problematic

2.1.3 Data collected by IRC

In July 2014 a survey was conducted at half the camp's water points (19 tap stands and the single hand-dug well still in use) for four consecutive days. The objective was to determine water quantities fetched per water point per day, per household and per capita. Those who came to fetch water ("visitors") were asked about household size and the location of their house (block)[3]. First, water points were identified on a map based on crowding criteria. Half the water points in each of three zones were identified. This selection was discussed and adjusted during a workshop with data enumerators, all refugees (Table 7).

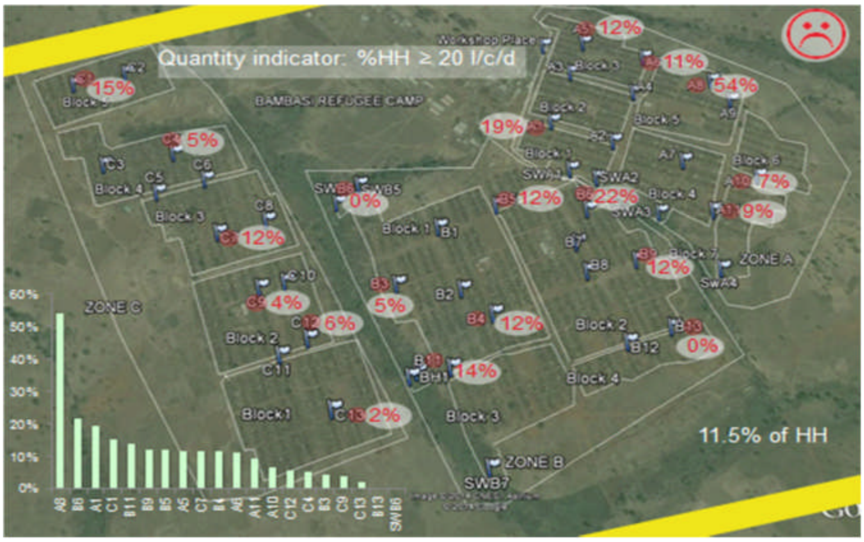
Table 7 Location of tap stands selected for water point survey

Level of crowding (visitors per day)	Zone A	Zone B	Zone C	Tap stands selected for survey	Tap stands in camp
Low (below 40)	2	2	1	5	9
Middle (40 to 60)	2	2	1	5	10
High (above 60)	2	3	4	9	16

The quality of the water delivered by the 19 sampled tap stands was tested by UNHCR in August 2014. The crowding indicator came from a count of visitors at each water point and the calculation of the total number of users (visitors * household size). Distance was observed by comparing GPS coordinates of each visitor's block to the water point.

Results of the water point survey differed substantially from the WASHCard data. The average quantity of water collected was below 10 litres per capita per day. Only 11.5% of the sampled households collected more than 20 litres per capita per day (Figure 3), and 67% households scored a critical level of service (less than 10 litres per capita per day) (Figure 4).

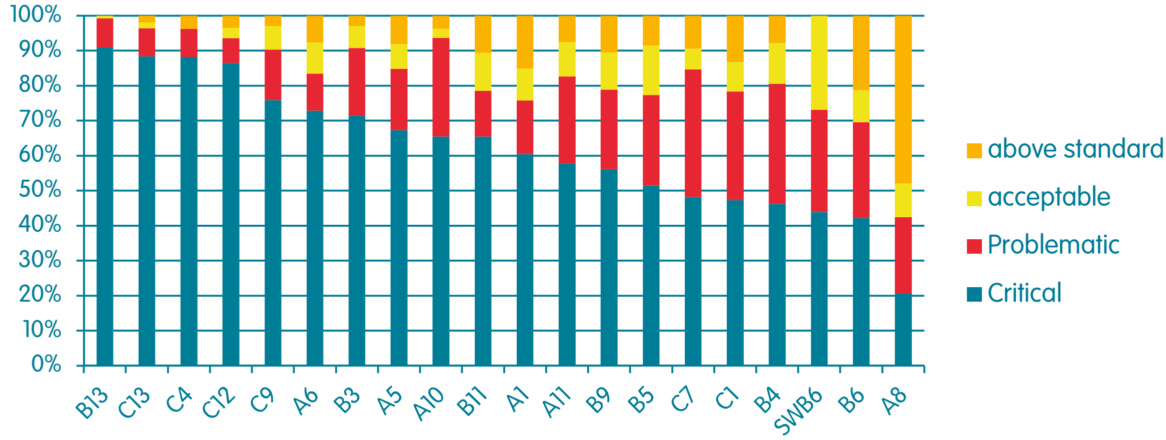
Figure 3 Tap stands and percentages of households receiving above-standard service



Source: Own elaboration, based on survey (2015), based on Google Earth (2015)

[3] See methodological report: http://www.ircwash.org/news/methodology-cost-water-services-refugee-context ; and data collection tool implemented in Bambasi: http://www.ircwash.org/blog/assessing-water-service-levels-refugee-camp-bambasi-ethiopia.

Figure 4 Observed service level, by quantity per tap stand

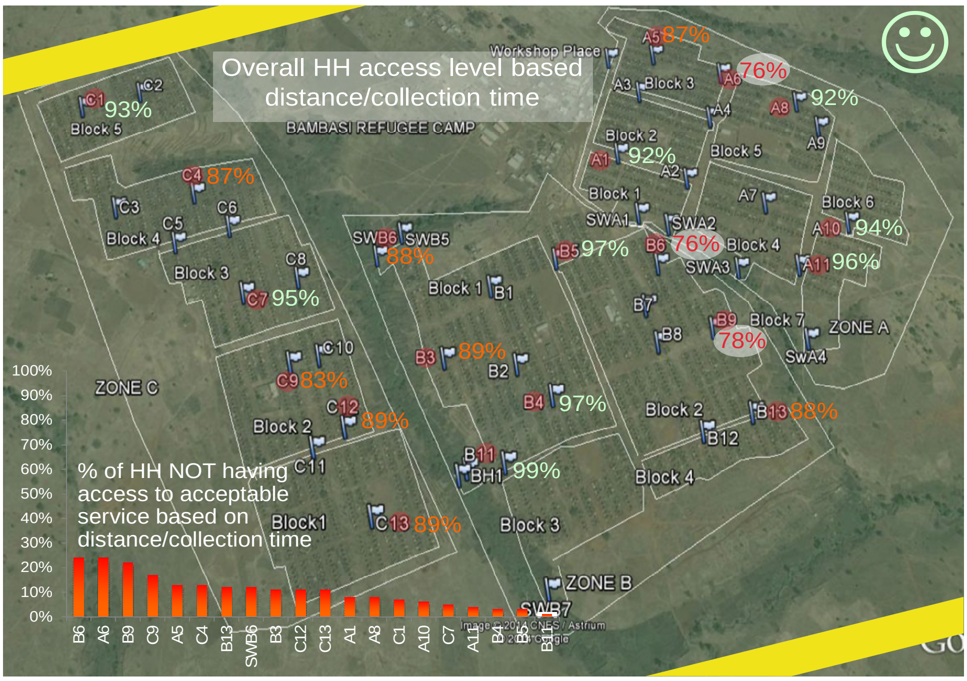


Water quality testing showed that each tap stand surveyed supplied water of only acceptable quality. As a consequence, no household sampled received an above-standard level of service, even those collecting more than 20 litres per capita per day.

On distance, 11% of sampled visitors lived more than 200 metres away from the water point where they fetched water (Figure 5).

Crowding remained below 100 refugees per tap, for all tap stands surveyed.

Figure 5 Sampled water points and percentage of users (households) 200m or less from water point



Source: Own elaboration (2015), based on Google Earth (2014)

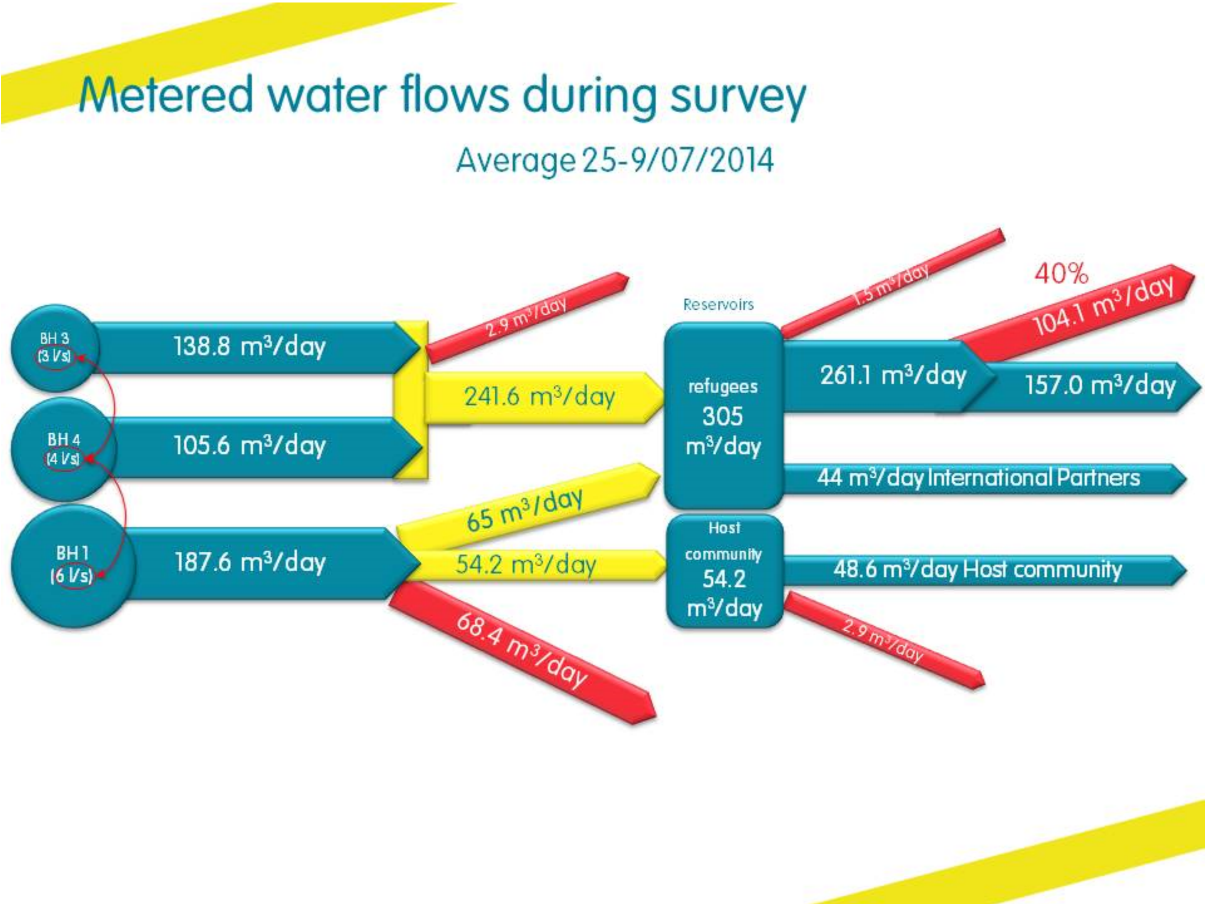
Overall, 67% of sampled refugees received a critical level of service, 12% a problematic level of service and only 21% an acceptable level of service. None received an above-standard level (Table 8).

Table 8 Observed service levels, by camp zone

		Indicator				
Zone	Level of service	Quantity	Quality	Distance	Crowding	Aggregated
A	Above standard	7%	0%	90%	100%	0%
	Acceptable	16%	100%	10%	0%	23%
	Problematic	13%	0%			13%
	Critical	64%	0%		0%	64%
B	Above standard	7%	0%	89%	100%	0%
	Acceptable	18%	100%	11%	0%	25%
	Problematic	14%	0%			14%
	Critical	61%	0%		0%	61%
C	Above standard	6%	0%	89%	100%	0%
	Acceptable	7%	100%	11%	0%	13%
	Problematic	9%	0%			9%
	Critical	78%	0%		0%	78%
Overall	Above standard	7%	0%	89%	100%	0%
	Acceptable	14%	100%	11%	0%	21%
	Problematic	12%	0%			12%
	Critical	67%	0%		0%	67%

Metered data at boreholes and water tanks were captured during the four days of the survey, and the quantity metered was compared with the quantity data collected at each water point surveyed. The comparison showed that 40% of the water pumped was apparently lost along the distribution network (Figure 6). Leakages could explain why the quality of water has tended to deteriorate over time. Alternatively, one or more meters might be unreliable and should be replaced to ensure accurate monitoring.

Figure 6   Water pumped, distributed and lost, July, 2014



Source: Own elaboration

2.2 Service levels at Camp Kounoungou, Chad

Photo: Camp Kounoungou, Chad (IRC, 2014)

Camp Kounoungou opened in 2005 and hosted almost 21,600 refugees in 2014 (Table 9). A pipe scheme was built at the outset and regularly extended with additional tap stands (for a total of 40 water points and 228 taps in 2014) plus institutional taps for the camp's health centre and school, HCR, Secadev, traditional chief's compound and supply distribution centre, and taps for the nearby hosting community's market and hospital. In addition to the pipe scheme, five hand pumps and two tap stands equipped with solar panels have been built. One institutional tap is also used by refugees as a water point.

Table 9 Water systems and population

Year	Technology	Water points	Taps with 100% functionality*	Functioning taps	Refugees (households)
2005	Pipe scheme	14	84	NA	11,016 (2,300)
2006	Pipe scheme	24 +1 (instit.)	144 + 1	NA	12,544 (2,647)
2007	Pipe scheme	29 + 2 (instit.)	174 + 2	104	12,588 (2,656)
2008	Pipe scheme	29 + 2 (instit.)	174 + 2	114	18,199 (3,967)
2009	Pipe scheme	33 + 2 (inst.)	198 + 2	129	18,967 (4,185)
2010	Pipe scheme	33 + 4 (instit.)	198 + 4	120	19,083 (4,216)

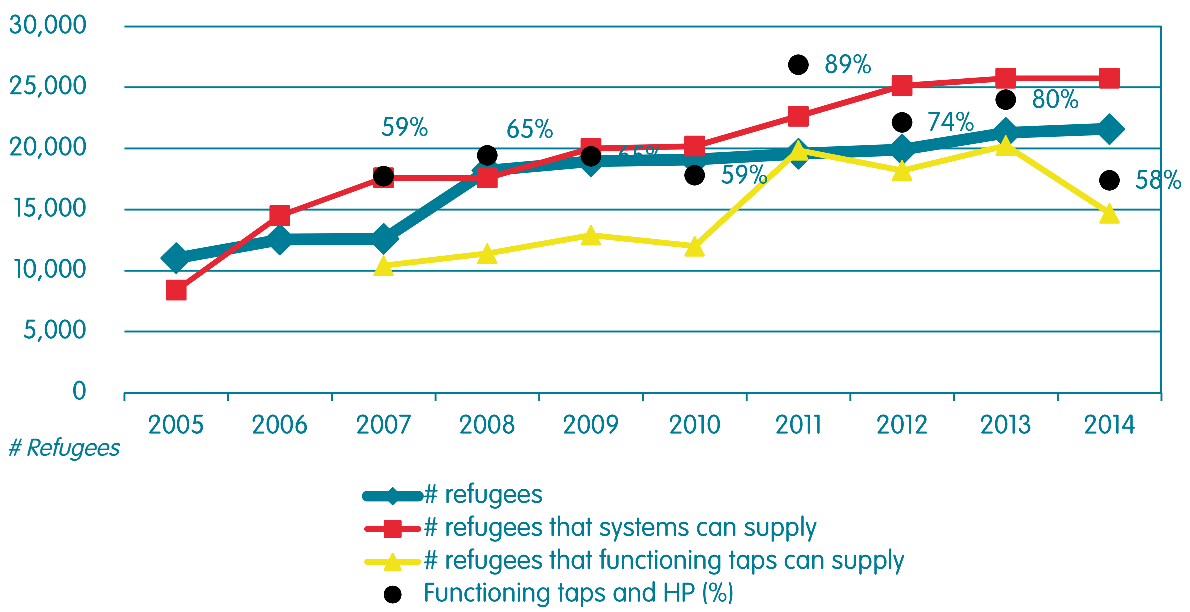
Year	Technology	Water points	Taps with 100% functionality*	Functioning taps	Refugees (households)
2011	Pipe scheme Hand pump	35 + 4 (instit.) 5	210 + 4 5	191	19,558 (4,335)
2012	Pipe scheme Hand pump Solar panels	39 + 5 (instit.) 5 2	222 +5 5 12	176	19,902 (4,424)
2013	Pipe scheme Extension to HC Hand pump Solar panels	40 + 5 (instit.) 2 5 2	228 + 5 12 5 12	195	21,282 (4,783)
2014	Pipe scheme Hand pump Solar panels	40 + 5 (instit.) 5 2	228 + 5 5 12	141	21,592 (4,872)

* with 6 taps per tap stand; 1 tap per hand pump; 1 tap per institutional tap

2.2.1 Expected level of service

Assuming 100% functionality, each tap should supply 100 people, and each hand pump, 250. Figure 7 shows that, except in 2005 and in 2008, the systems were, per design (red line), sufficient to provide above-standard service to all refugees (blue line). These water points were also designed to deliver safe water, complying with UNHCR's quality standards, and be located less than 200 metres from where users live. The yellow line indicates how many users were actually served, given that not all taps were functional.

Figure 7 Water supply per design and refugee population, 2005–2014



2.2.2 Data reported to UNHCR

The above figure also shows that functioning taps and hand pumps could not, except in 2011, cover all refugees according to UNHCR standards. Tables 10 and 11 synthesize the information reported to UNHCR from 2007 to 2014.

Table 10 Reported service levels, by indicator, 2007–2014

	2007	2008	2009	2010	2011	2012	2013	2014
Quantity (l/c/d)	13.2	14.2	15.0	14.6	14.7	14.8	16.5	16.9
Quality | Chlorinated water | FRC (mg/l)	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5	0.1 to 0.5
Quality | Unchlorinated water | *E. coli* (cfu)	0	0	0	0	0	0	0	0
Distance to closest water point (m)	250	250	230	220	200	150	150	150
Crowding (c/tap and HP)	121	160	147	159	102	113	109	153

Table 11 Reported service levels, 2007–2014

	2007	2008	2009	2010	2011	2012	2013	2014
Quantity	Problematic	Problematic	Acceptable	Problematic	Problematic	Problematic	Acceptable	Acceptable
Quality	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Distance	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Above standard	Above standard	Above standard
Crowding	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
Aggregated level	Problematic	Problematic	Acceptable	Problematic	Problematic	Problematic	Acceptable	Acceptable

Above standard Acceptable Problematic

2.2.3 Data collected by IRC

The water point survey took place between December 9 and 12, 2014. As in Camp Bambasi, it was designed to last four consecutive days at a representative sample of water points, with data collected with smartphone technologies. However, the camp's allotment plan was not up to date (the most recent plan was dated 2010) and omitted several zones and the locations of six tap stands. Additionally, population data per block were not available. Because it was difficult to make assumptions about water point density and select a representative sample., the research team relied on information provided by data enumerators, who were asked in a workshop to categorise crowding patterns for all 40 tap stands in the camp.

Half of the 60 data enumerators lived in the camp. According to them, refugees fetched water more than once a day, including from one institutional tap (the Secadev tap). Some water points were therefore crowded, with people coming back three or four times per day, but delivered water to fewer users than less crowded water points. Thus, it would be possible to get an accurate count of the number of visitors but not the number of users.

We therefore decided to modify the sampling strategy to survey all water points–the 40 tap stands, five hand pumps and one institutional tap. Thirty teams, each with two data collectors, surveyed half the water points on the first two days of the survey, and then surveyed the other half on the following two days. IRC trained UNHCR and Secadev staff on administering the questionnaire and using mobile phone technology. These staffers then trained the data collectors, supervised the data collection and exported the data into the cloud.

Another important difference with the Camp Bambasi observations is that the opening time of tap stands was changed for the survey. For security reasons, the camp is closed from 14:00 until 8:45 the following morning, but the tap stands are open earlier and closed later. It was therefore decided, in agreement with the representative of the camp and the refugees, that opening of the water points would be changed during the survey to comply with security restrictions. To monitor the effect of this change on the quantity of water collected, UNHCR and Secadev staff would read the water meters of the pipe scheme every day the week before the survey and during the four days of the survey.

IRC expected to receive two data series for each water point, one for each of two days, but in fact received from zero to four daily data series (Table 12). Some water points were surveyed twice by different teams, and some teams surveyed more than one water point in a single day. One team even collected data on a hand pump that was not functioning. Water meters were read only one day before the survey instead of a week, making it difficult to assess how changing the opening time of water points affected the results.

Table 12 Water point survey data series

Days with data	0	1	2	3	4
Water points surveyed	2	4	12	8	11

To calculate the quantity delivered by each water point, the research team decided to average the quantity fetched at each water point per day, since two or more days' worth of data had been collected for 31 of 36 water points.

Only 2,478 visitors came to the water points in four days, accounting for 7,520 users, compared with a registered population of 21,592 (Table 13). Most came only once per day, in contrast to what refugees had said during the workshop, probably because of the change in opening time of water points.

Table 13 Households surveyed at water points

HH size	# of HH	Total # people
0	335	0
1	242	242
2	625	1250
3	502	1506
4	170	680
5	337	1685
6	100	600
7	33	231
8	49	392
9	8	72
10	53	530
11	0	0
12	10	120
13	1	13
14	0	0
15	11	165
16	0	0
17	2	34
TOTAL	**2478**	**7520**

No water quality testing was conducted during the survey. And because the lack of updated plans made it difficult to estimate the distance from each household to the closest water point, visitors were asked whether they had walked more or less than five minutes to the water point. Based on these assumptions, final levels of service observed are described in Table 14.

Table 14 Observed service levels, December 2014

	Quantity	Quality	Time	Crowding	Aggregated
Above standard	19%	NA	85%	75%	19%
Acceptable	16%	NA	15%	24%	16%
Problematic	20%	NA			20%
Critical	45%	NA		1%	45%

Not counting water quality, 19% refugees were provided with an above-standard level of service. As in Camp Bambasi, the driving indicator was quantity: 45% of users collected less than 10 litres of water per day per capita. In terms of time to water point (a proxy for distance), 85% of refugees had above-standard service, and in terms of crowding, 75%.

2.3 Summary of service levels

The level of service provided in the two camps were analysed by three measures:

- *The service as designed.* Information on the infrastructure built to supply safe water was compared with the UNHCR standards to assess whether the investments were sufficient for each camp's population.
- *The service as reported.* Monitoring required by UNHCR gave information on the functionality of water points and the registered population.
- *The service received.* The data collected at water points described the level of service that was actually received by refugees.

In Camp Bambasi, the level of service per design is above standard. The camp is recent, and the infrastructure was designed to last two to three decades and supply safe water to a population twice as large as it served in 2014. As reported to UNHCR, the level of service provided was acceptable in 2013 but fell to problematic in 2014 because of water quality issues. (The quality problem has since been solved by closing shallow wells.) As observed over four days, two-thirds of refugees received a critical level of service: although the water quality was acceptable, 67% of refugees fetched less than 10 litres per capita per day of safe water.

Volumes of water produced and demanded (reported and observed) explain the discrepancy in the levels of service. It is crucial to systematise the reading of meters in Bambasi and include the functionality of meters in the monitoring system, currently limited to water points.

Based on the available information, leakage is responsible for an average loss of 40%, which is high for a two-year-old pipe system. Meters may not be reliable, or demand may actually be low. A regular assessment of the demand is crucial for deciding whether to support stimulating demand (soft activities) or to change the standard and redesign the infrastructure, if the health objective can be met with less water.

Regularly collecting service-level data on actual demand at water points may not be possible. However, demand changes with the season and should be monitored on a regular basis. Questions about demand should be part of the existing monthly household survey.

In Camp Kounoungou, the level of service per design has been above standard since 2006 except in 2008. The infrastructure could supply 15% more refugees than the current registered population. As reported to UNHCR, the level of service was mainly problematic until 2012 because of insufficient water quantity but ranked as acceptable in 2013 and 2014. Multiple extensions have increased the volume of water produced and improved the distance indicator to above standard. Non-functionality of taps accounts for the difference between the reported and the per design level of service (40% of taps were not functioning in 2014).

As observed by IRC, a large majority of refugees receive an above-standard level of service in terms of time (distance) and crowding, while the rest receive acceptable service. However, 45% receive a critical level of service in terms of quantity (less than 10 litres per capita per day) and 20% a problematic level (10 to 15 litres per capita per day). As a consequence, only one third of refugees receive an acceptable or above-standard level of service. That result might reflect the change in opening times of the tap stands during the survey, which may have disrupted refugees' habits. Here again, regular monitoring of water demand could enrich the assessment of the service provided if questions about water quantity, quality, time or distance and crowding were included in the household monthly surveys.

Whether reported or observed, the level of water service provided and received by refugees in these two camps is remarkable compared with regular settlements in Africa. Rural areas and small towns are unlikely to have infrastructure designed to supply the entire population with at least 20 litres per capita per day of water whose quality is regularly monitored. Distance (or time) and crowding standards are less demanding, with a typical distance of 500 meters to a tap stand and 1 km to a shallow well or hand pump, and a typical crowding of 500 people per tap and 300 people per shallow well or hand pump). Studies have shown that 80% to 100% of Africa's rural population receives only a critical level of service.

3 Comparing planned versus real expenditures, cost components and unit costs

This section analyses the cost of water provision. As for the analysis of the service level, we consider the cost per design, the cost as reported and the cost as observed. Costs are analysed per component, per system, per capita and per cubic metre of water (m3).

The data for cost per design come from budgets, whereas reported and observed costs are actual expenditures. For the unit costs (per capita and per m3), reported costs consider the population registered in the camp and the volume of water made available, whereas observed costs consider the population as determined by the water point survey and the actual demand for water.

Table 15 defines the life-cycle cost components of a water service in a refugee camp.

Table 15 Life-cycle cost components of water service, adapted to refugee context

Type of cost component	Component	Definition
System related	Capital expenditure (CapEx)	Capital invested in constructing or purchasing fixed assets (e.g., concrete structures, pumps and pipes, boreholes, reservoirs) includes initial emergency water system and permanent water system plus any extensions. It also includes one-off software (e.g., community training and consultation, design, procurement).
	Operational expenditure (OpEx)	Operating and minor maintenance typically comprises regular expenditure such as labour, fuel, chemicals, spare parts, and purchases of any bulk water, in particular during emergency phase.
	Capital maintenance expenditure (CapManEx)	Capital for asset renewal and replacement consists of occasional and 'lumpy' expenditures to restore system functionality (e.g., replacing pump rods in hand pumps, diesel generator in motorised systems).
Management related	Expenditure for direct support (ExDS)	Direct support is structured support to camp or settlement office of international agency to organise, operate and report on provision of water service. It includes all expenditures made locally by agency to appoint international staff and hire local staff, plan and operate water facilities, monitor and report to headquarters and funders.
	Expenditure for indirect support (ExIDS)	Indirect support covers expenditures made by international agencies and UNHCR to develop strategies and policies and coordinate humanitarian interventions to provide water services to refugees.

3.1 Costs for Camp Bambasi

Cost data have been extracted from budgets and financial reports for 2012 through March 2014. It is thus possible to compare planned with real expenditures and identify deviations per cost component from June 2012 through March 2014. Cost components were analysed per system and over time, and unit costs based on reported data were compared with unit costs calculated with observed data.

3.1.1 Budgeted and real expenditures

Table 16 Budgeted and real expenditures, by cost component, 2012–2014

US$ 2014	Budgeted	Spent	Deviation
CapEx			
Initial piped scheme	1,076,934	1,079,114	
Extension to institutions in the camp	26,726	24,941	
Extension to host community	220,735	212,360	
Total scheme	1,324,396	1,316,415	-1%
OpEx			
2012	159,260	177,013	11%
2013	35,348	24,426	-31%
2014	82,865	*19,411 **	*-30%*
Direct Support			
2012	112,893	108,726	-4%
2013	79,255	81,854	3%
2014	61,093	*19,399 **	*-5%*
Indirect Support			
2012	16,655	16,610	-0.3%
2013	11,486	7,965	-31%
2014	15,060	*1,406 **	*-72%*

* in four months

The main deviation relates to operational expenditure (OpEx), which covers rented equipment (e.g., trucks), energy (e.g., fuel), chemical cleaning products and the guards stationed at boreholes and tanks. (The cost of plumbers, technicians, engineers and managers is considered direct support.) In 2013 and 2014, the cost of operating the permanent system was 30% below budget[4].

The OpEx budgeted for 2014 was 3.5 times more than the actual OpEx in 2013 ($82,865 versus $24,426[5]). This increase cannot be attributed solely to the extension to the hosting community, which represented only a 20% increase in population served. However, the real expenditure in the first quarter of 2014 ($19,399) was already 80% of what was spent on OpEx throughout 2013. So even though the budgeted OpEx seems high, there was indeed a substantial increase in expenditure on fuel, chemical products and guards from 2013 to 2014.

[4] Assuming OpEx in 2014 is three times the amount of the first quarter.
[5] All monetary values are expressed in 2014 U.S. dollars.

3.1.2 Real expenditures per cost component and per system

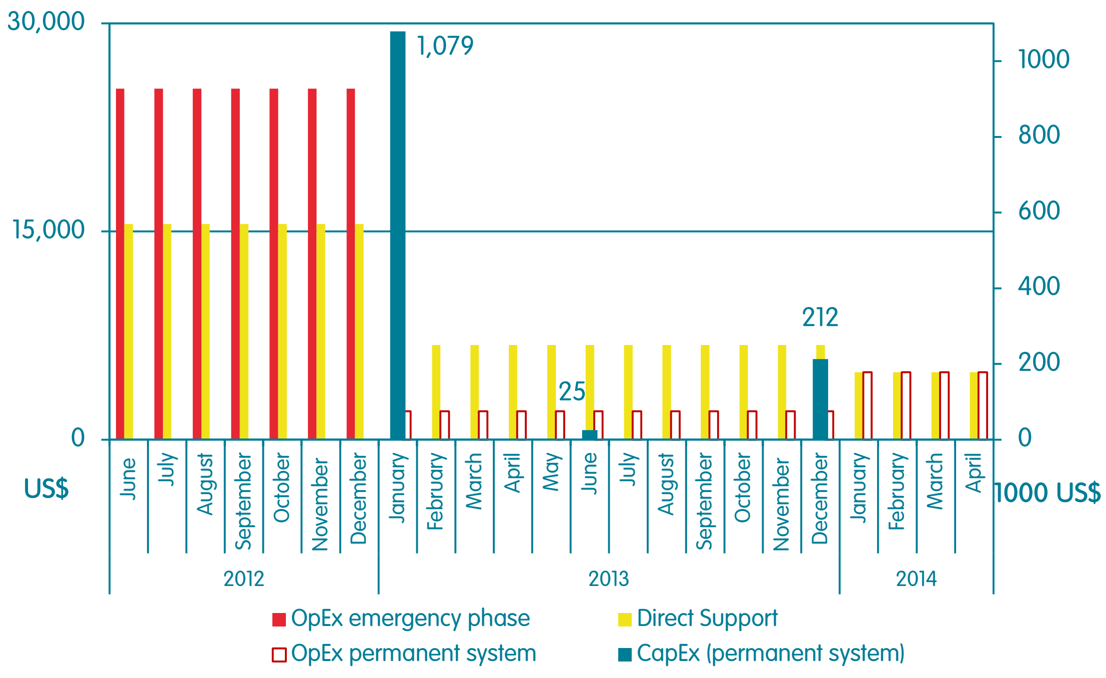
The cost structure differs drastically between the emergency system (2012–2013) and the permanent system (from January 2013). On average, operation of the permanent system cost $3,500 per month, or seven times less than for the emergency system (Figure 8).

The emergency system involved no capital investment, but more than $25,000 per month was spent on water tank vehicles, cleaning and guards. Together with the initial support required to set up and manage the provision of water, the monthly expenditure averaged $40,820.

Note that 44 months of OpEx on the emergency system equals the investment in the permanent system for the whole camp (refugees and institutions). Thus, in this case, the investment in a permanent system is justified if the camp operates more than 3.6 years.

A total of $1,316 M was invested in the water system for Camp Bambasi between 2012 and 2014. Less than 2% was allocated to supply the school, medical centre and partners. The investment to supply the hosting community represents 16% of the total investment, or 19% of the investment made for refugees ($1,104 M).

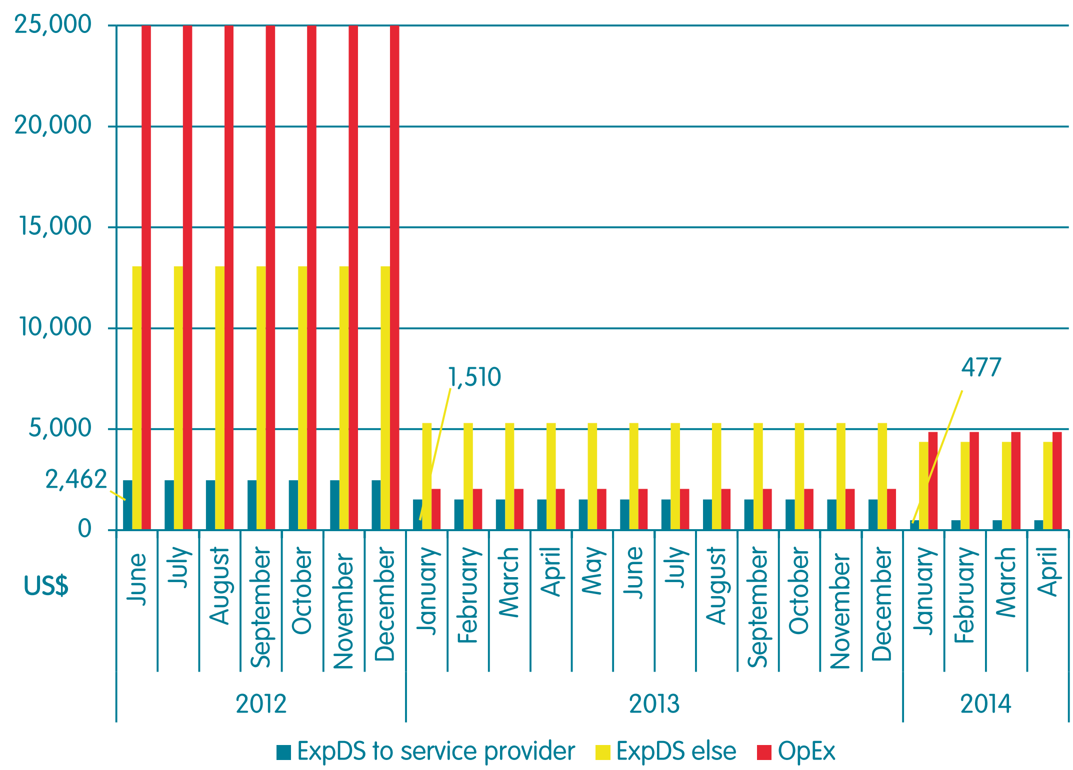
Figure 8 Capital and recurrent expenditures, 2012–2014



In 2014, the OpEx on the permanent system was 2.4 times larger than in 2013. OpEx is largely driven by the quantity of water pumped and treated. Unless the level of leakage was similar in 2013, most of the increase in 2014 may be due to leakage: each day, the system loses 178.5 m3, which represents 3.7 times the volume distributed to the hosting community.

Like OpEx, the expenditure on direct support (ExDS) dropped, from $15,532 to $6,821 per month, after the camp switched to the permanent system in January 2013 (Figure 9). What is surprising is that it falls again in 2014, down to $4,850 per month, even though the system is larger because of the two extensions completed in 2013. Half of this decrease is explained by the lower expenditure on direct support to the service provider, which was $2,462 in the emergency phase but $477 in 2014.

Figure 9 Operational and support expenditures, 2012–2014



During the emergency phase, ExDS was 40% of OpEx. In 2014, the two cost components were virtually the same, about $5,000 per month each. The annual recurrent expenditure reaches 9% of the investment cost and OpEx accounts for only 4.5%.

3.1.3 Reported and observed unit costs

By definition, population and volume considerably affect unit costs. Table 17 gives the investment per capita with the camp's registered population (July 2014) and observed population (December 2014).

Table 17 Capital investment per capita, reported and observed

	Unit cost	
	Reported population, 13,847	Observed population, 9,671
Total CapEx	**95**	**136**
Initial permanent system	78	112
Institutional extension	2	114
Extension to hosting community	15	22

The total investment made in the camp was $95 per capita, based on the 13,847 refugees registered in July 2014. This unit cost includes $78 to supply all refugees through 278 tap stands, $2 to supply the school, medical centre and partners, and $15 to supply 2,400 users from the hosting community. But with the population as determined from the survey, the CapEx per capita is almost 43% higher, at $136 per capita.

Recurrent costs have been annualised so that we can compare reported with observed unit costs, whether per capita, per m3 or per tap, across time and systems. For instance, to compare OpEx per capita between the emergency and the permanent systems, the cost of operating the emergency system for seven months has been annualised to make it comparable to the cost of operating the permanent system for a full year. Similarly, the recurrent expenditure on the permanent system in the first quarter of 2014 has been multiplied by 4 to get an annualised expenditure.

Table 18 Operational and support expenditures, per capita and per volume, by year

	Refugee population (water volume)			
	Reported, 2012: 12,133 (volume not available)	Reported, 2013: 12,882 (103,290 m3)	Reported, 2014: 13,639 (38,520 m3)	Surveyed, July 2014: 9,671 (19,152 m3)
OpEx per capita	$25	$2	$4	$6
ExDS per capita	$15	$6	$4	$6
OpEx per tap	$1,394	$88	$208	$214*
OpEx per m3	na	$0.20	$0.50	$1

In the emergency phase (2012), water provision cost $40 per capita per year in recurrent expenditures versus an average of $8 with the permanent system, based on the registered population. With an observed population that is 30% less, however, the 2014 recurrent expenditures for the permanent system were $12 per capita per year, or $1 per person per month.

3.2 Costs for Camp Kounoungou

Cost data come from budgets and financial reports. Some documents were missing, however, precluding systematic analysis.

3.2.1 Budgeted and real expenditures

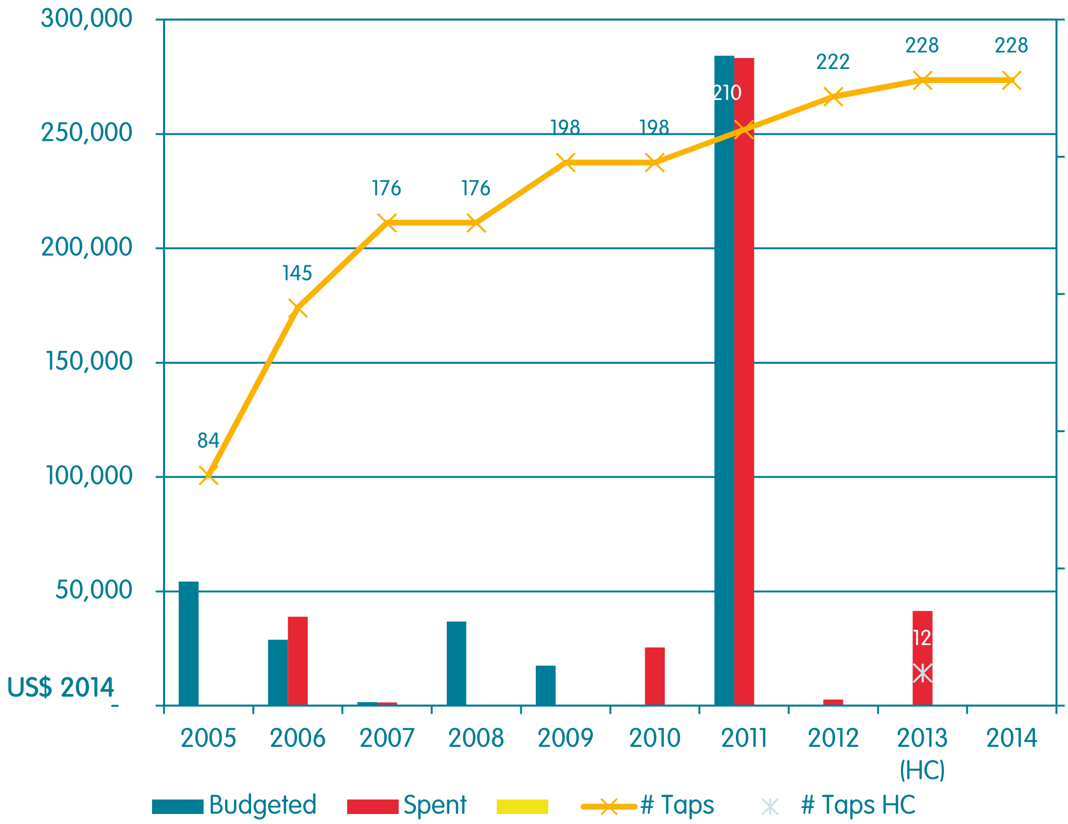
The budget for 2010 and the financial reports for 2008, 2009 and 2014 were not available. In 2005, the financial report did not show any expenditure for investment, even though the pipe scheme was built in this year. In 2012 and 2013, the budgets did not include any investment planned for the pipe extension, even though five tap stands were built during this period. Finally, the solar panels were partially financed by Oxfam, and no budget or financial reports pertaining to their construction could be found.

Consequently, the analysis is hampered by the following constraints:

- Partial budget and partial real expenditure figures on the pipe scheme (both the initial system and the in-camp extension)
- No budget figures for the extension of the pipe scheme to the hosting community
- No real expenditure figures for hand pumps
- Incomplete budget and incomplete real expenditure figures for solar panels

For the pipe scheme, there is no clear relationship between the amounts budgeted and spent on extensions inside or outside the camp (Figure 10). It is thus difficult to make assumptions.

Figure 10 Investment budgeted and spent on pipe scheme, 2005–2014



If we consider the total amount spent on the pipe scheme since 2005 and add the budgeted amounts for 2005, 2008, 2009 and 2014, the total investment for this system was $501,475.

For the five hand pumps, $24,498 was budgeted. For the two solar panels with one tap stand each, an incomplete budget of $6,115 was reported in 2011, as well as an incomplete expenditure of $5,766 the same year.

Hence, an estimated $525,973 was invested in the pipe scheme and hand pumps between 2005 and 2014, and more than $5,766 in the solar system.

3.2.2 Cost components by system

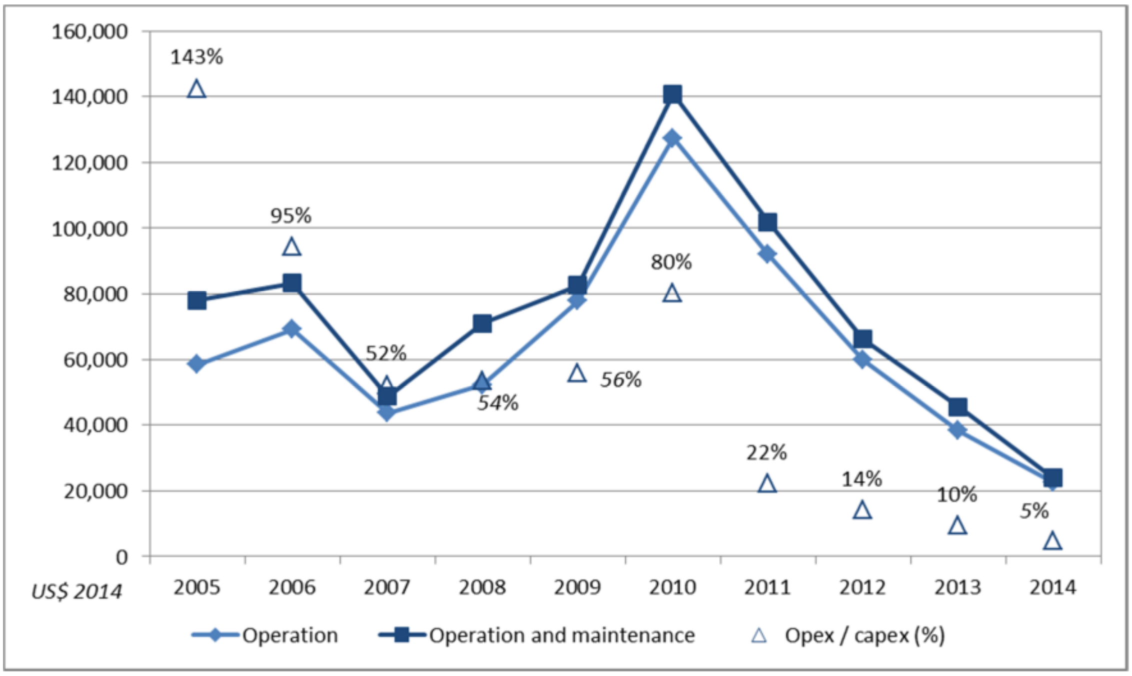
Operational expenditures

Real OpEx data are missing for 2008, 2009 and 2014 for all systems. We thus consider budgeted expenditure for these three years.

Pipe scheme. Operation and maintenance expenditure varies by a factor of 6 (Figure 11). This variation does not follow the number of functioning taps, which increased to 190 in 2011 from 120 the year before, when operation and maintenance expenditures were highest. The maintenance component is relatively limited, ranging from $1,214 in 2014 (budgeted) to $19,726 the first year the pipe scheme was operated. Operation accounts for 74% to 95% of the total operation and maintenance expenditures.

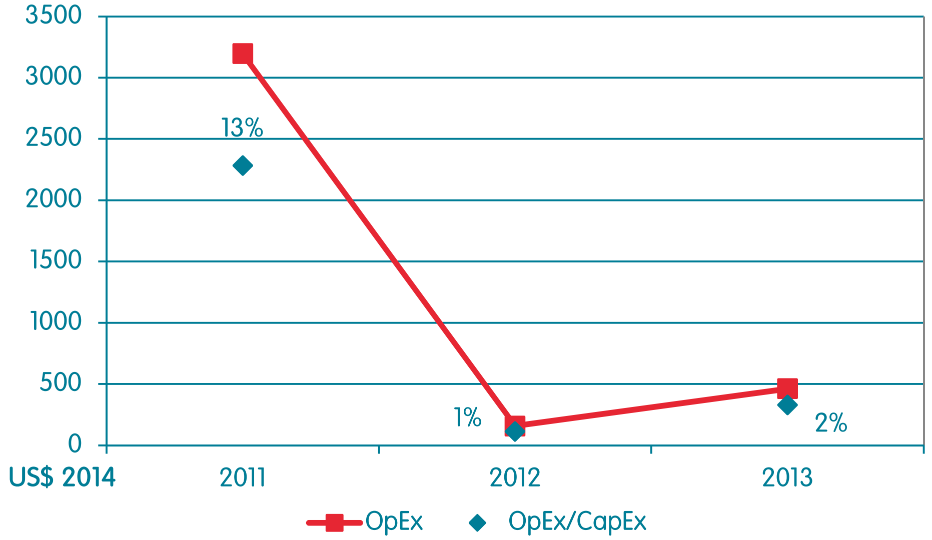
From 2005 to 2010, annual OpEx represented almost 150% of the capital investment. In 2005 and 2006, about $200,000 was spent to operate and maintain a system that cost less than $150,000 to build. The proportion of OpEx to CapEx has decreased from 22% in 2011 to 10% in 2013, and only 5% was budgeted for OpEx in 2014.

Figure 11 Operational expenditures for pipe scheme, 2005–2014



Hand pumps. OpEx on hand pumps varies from $159 to $3,196, representing 1% to 13% of the capital investment (Figure 12).

Figure 12 Operational expenditures for hand pumps, 2011–2013



Solar systems. Only $306 was spent to operate and maintain the two solar systems in 2012. No chemicals were used to treat the pumped water: it is sand-filtered inside the tank. These systems are apparently not guarded, which explains why they cost so little to operate and maintain.

Capital maintenance expenditures

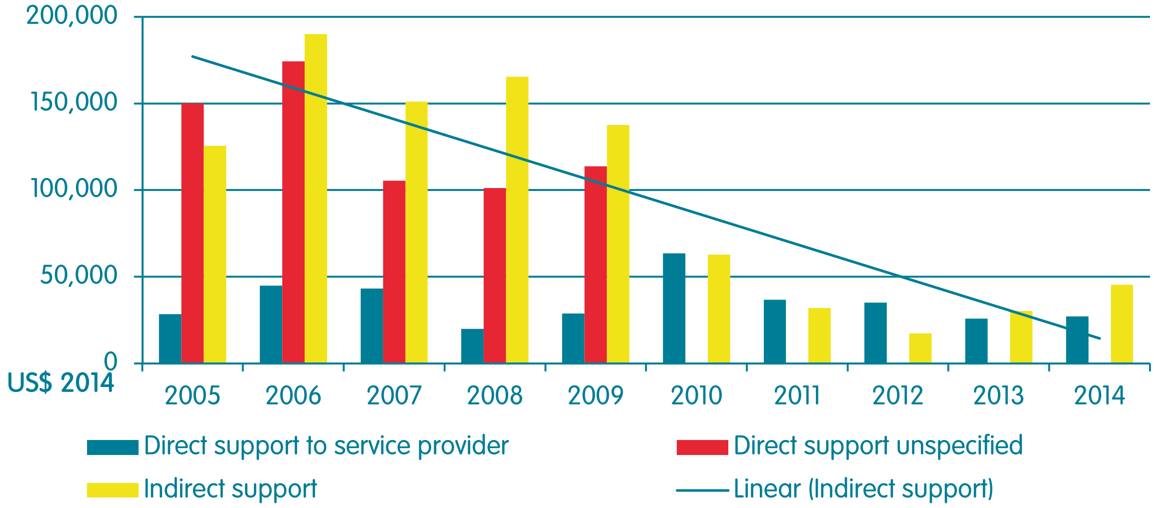
Pipe scheme. In 2010 and 2011, $42,542 was spent to replace major components. This represents a quarter of the cumulative investment in 2011, meaning that the life expectancy of the system should be 24 years, which is reasonable for developing countries.

Hand pumps. In 2011, hand pumps required $4,735 in capital maintenance. This is almost as much as the cost of a new hand pump, or 20% of the investment made to install the five hand pumps in 2010.

Direct and indirect support expenditures

The decrease in ExDS and ExIDS over time is impressive (Figure 13). Again, the data in 2008, 2009 and 2014 are budgeted amounts whereas the other years show real expenditure.

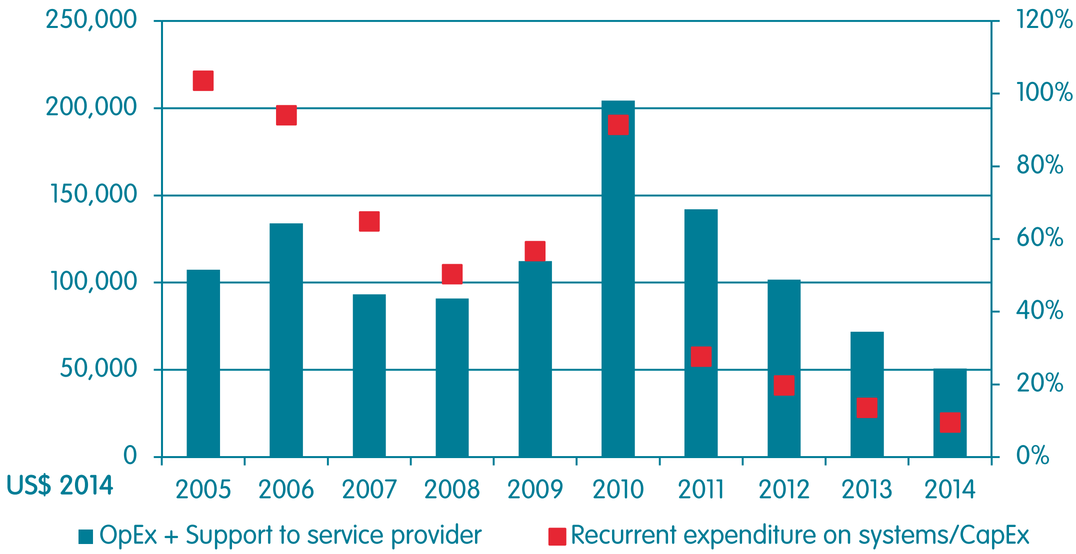
Figure 13 Direct and indirect support expenditures, 2005–2014



Direct support to the service provider was relatively constant over time, averaging $35,300 per year. Unspecified direct support simply disappears after 2009, probably because of a change in budget format and cost allocation. Expenditures on indirect support declined over time, from $190,000 in 2006 to $45,000 in 2014, likely because the headquarters costs were apportioned to a larger number of camps in Chad.

The recurrent costs were extremely high compared with cumulative CapEx for the first five years of the camp but have decreased, from 28% in 2011 to 10% in 2014, as planned (Figure 14).

Figure 14 Ratio of recurrent costs to investment



3.2.3 Planned, reported and observed unit costs

Capital investment

Investment cost per capita varies according to the population considered. The data reported to UNHCR do not indicate the number of users per system. However, systems are designed for a target number. It is thus possible to calculate unit cost per design. Similarly, we can extrapolate from the number of users observed during the survey at each type of water point to calculate observed unit costs.

Per design, the investment with the highest unit cost is a piped system, at $22 per capita (Table 19). The lowest unit cost, $5 for solar systems, is uncertain because the investment is incomplete. On average, and when the pipe scheme is weighted for comparison with the two other systems, the investment is $22 per capita–the same as for the pipe scheme alone. Note that it costs only $2 more per capita to build a pipe system that supplies pressurised water than to install hand pumps.

Table 19 Investment cost per capita, by design, reported and observed, 2014

	Per design	As reported	As observed
	Population, 24,050	Population, 21,592	Population, 7,520
CapEx	$22	$25	3.2.3.1.1.1 $71
Pipe scheme	$22		
Hand pump	$20		
Solar system	3.2.3.1.1.2 $5*		

* Incomplete data

With a reported population slightly lower than the population per design, the investment per capita averages $25 in 2014. But with an observed population that is only one third of the registered population, the investment per capita rises to $71.

Operational expenditures

OpEx per capita, based on the camp's registered population, decreases as the number of users increases, though in 2010 it rose to $7.38 per capita (Figure 15). Operational expenditures were for the pipe scheme and hand pumps in 2011, and for all three systems starting in 2012. However, there was no OpEx on the solar system in 2013 and 2014, and nothing was budgeted for hand pumps for 2014. Thus the OpEx per capita figures are based mostly on operation of the pipe scheme.

Figure 15 Reported operational expenditures per capita, 2005–2014

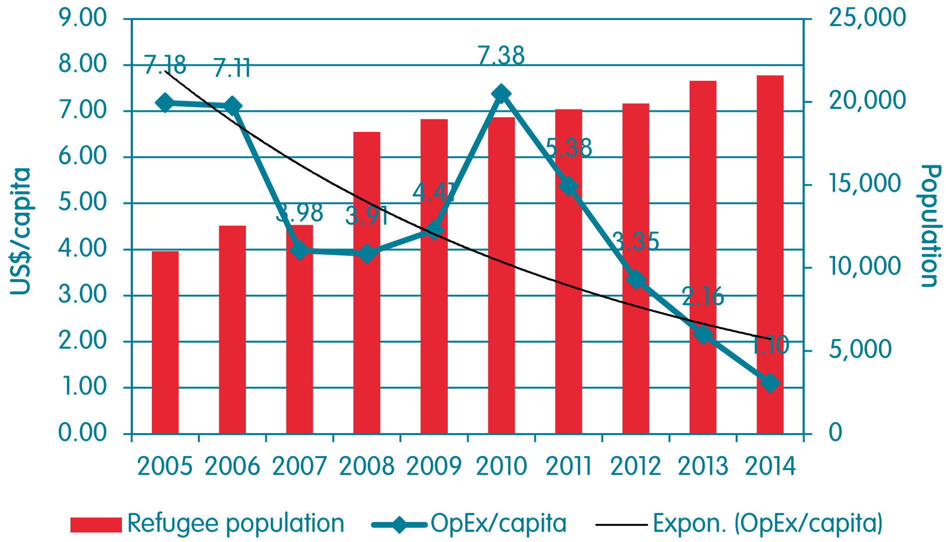
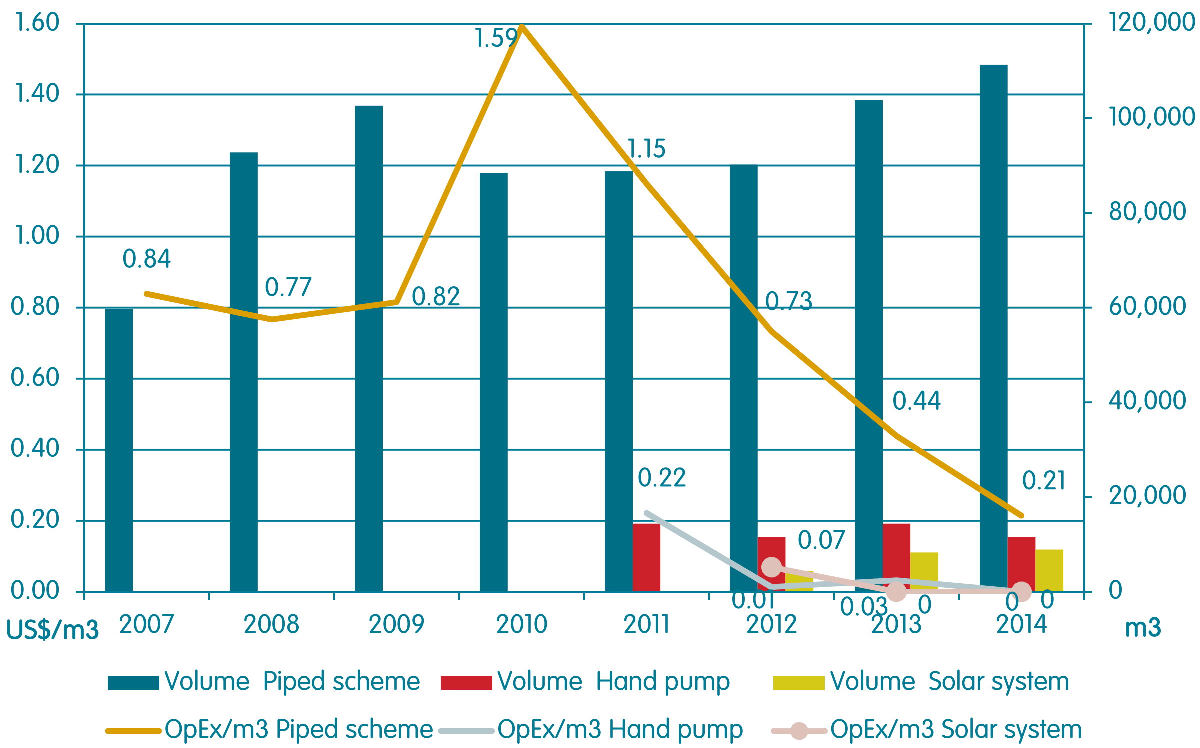


Figure 16 tracks the reported OpEx per m3 of water. Reported volumes are indicated for each system, which allows calculating the unit costs per system. For the pipe scheme, the expenditure decreases while the volume increases, down to $0.21 per m3, as budgeted for 2014. Water supplied through the solar system and the hand pumps costs very little in operation and maintenance.

Figure 16 Reported operational expenditures per m3, by system, 2005–2014



A difference between the reported volume and the volume counted at water points during the survey accounts for the differences in reported and observed OpEx costs. On December 8, 2014, the day before the survey, UNHCR and Secadev read the water meters of the pipe scheme and the two solar tap stands. Because the water meter of the pipe scheme is located between the submersible pumps and the decantation tank, it records only the water pumped, and not the volume distributed at the 40 tap stands and the five taps for camp institutions and the hosting community. However, the metered quantities are consistent with the quantity reported to UNHCR through the WASHCards, with 304 m3 per day for the pipe scheme and 24 m3 per day for the two solar systems.

Compared with the data for December 8, the daily volume of water pumped for the pipe scheme during the survey was 11% lower, on average. This may be a consequence of the change in opening hours of the tap stands. Though the same can be said for solar tap BF10, which is normally open at all times, we have some doubt about solar tap BF8, whose meter was unfortunately down during the survey. During the field visit, the water flow was very low because the solar panels were in the shade most of the time. Hence the metered quantity of 23,000 litres in one day (or 38 litres per capita for 600 refugees) looks questionable. Still, the difference between observed and metered quantities for the pipe scheme and the two solar tap stands is astonishing (Table 20). Conversely, the volume observed at the four functioning hand pumps was 34% higher than the volume reported to UNHCR (43 versus 32 m3 per day).

Table 20 Metered and observed volumes of water, by system, December 8–12, 2014

		Volume (m3)				
		Dec. 8	Dec. 9	Dec. 10	Dec. 11	Dec. 12
Pipe scheme	Metered	*316*	308	260	294	261
	Observed	—	44	42	30	40
Solar TS10	Metered	*3*	0	3	2	2
	Observed	—	0.6	0.3	0.5	0.3
Solar TS8	Metered	*23*	*meter out of order*			
	Observed	—	0.4	0.0	1.0	0.5
Hand pumps 2–5	Observed	—	43	43	43	43

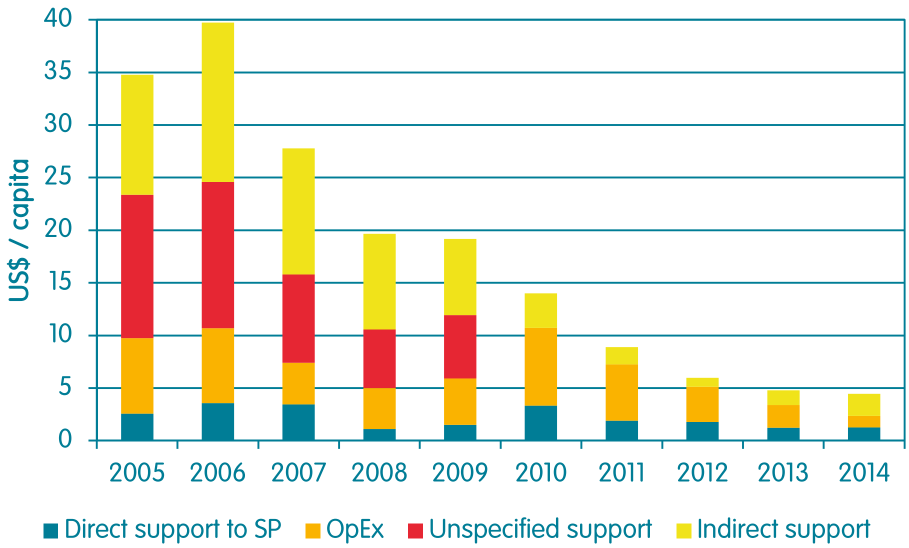
Consequently, the OpEx per m3 as observed for the pipe scheme, $1.75 per m3, was much higher than the reported $0.21 (both figures are based on the budgeted expenditure for 2014). With no budgeted expenditure for the operation and maintenance of the solar systems and the hand pumps, the OpEx per m3 stands at zero, regardless of the quantity.

For OpEx per capita, the difference between observed and reported figures is also very high. With an observed population of 7,520 people, the pipe scheme cost $3.17 per capita to operate in 2014 (again based on the budgeted expenditure), versus $1.10 per capita using the reported population of 21,592.

Direct and indirect support expenditures

Support expenditures per capita decreased significantly over time (Figure 17). In the first three years of the camp, total support per capita ranged from $23 to $32 per year, equally shared between direct and indirect support. The budgeted amounts dropped to around $15 per capita per year in 2008 and 2009. In 2010, total support per capita dropped to $6.60 per capita and has varied from $2.60 to $3.50 per capita per year since 2011, almost equally shared between indirect support and direct support to the service provider.

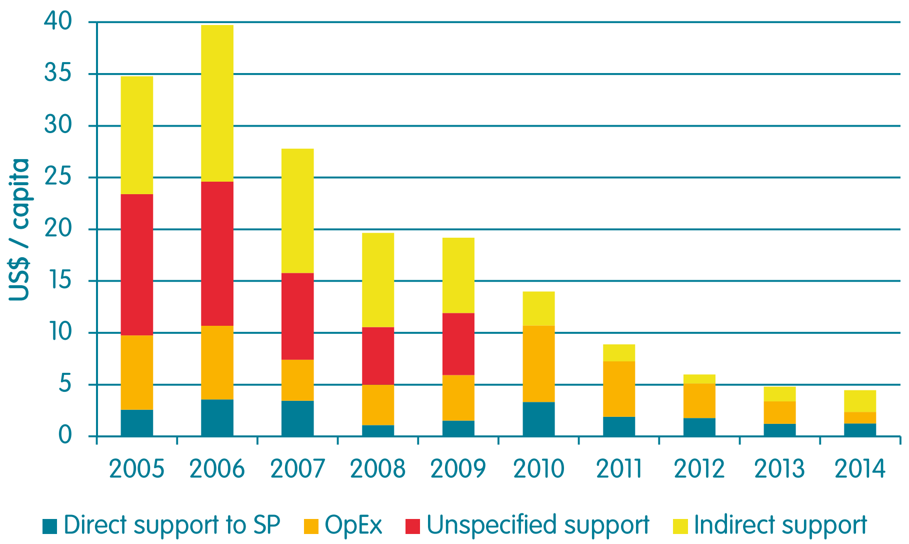
Figure 17 Support expenditures per capita, 2005–2014



Total recurrent expenditures

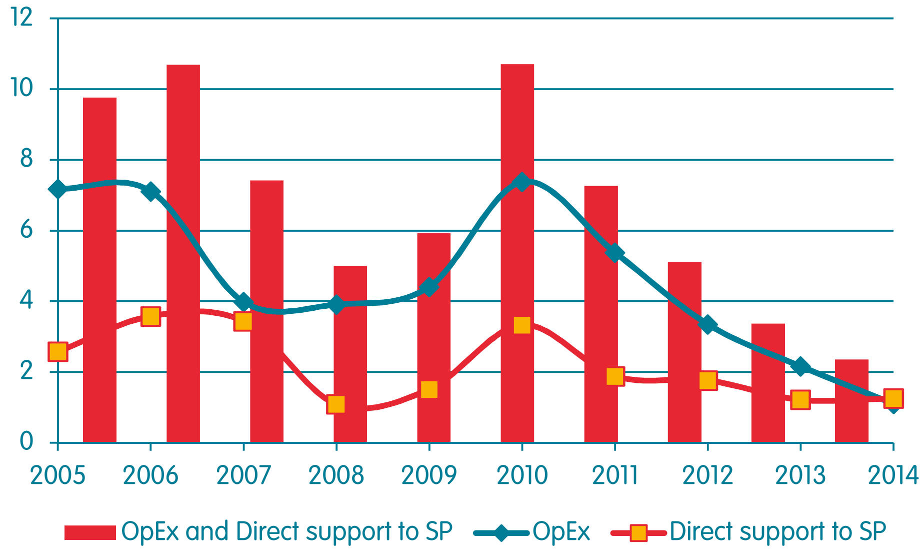
More was spent on management costs (unspecified direct support and indirect support) than on systems (OpEx and direct support to the service provider) from 2005 to 2009 (Figure 18). OpEx has been the largest component since 2010, although decreasing year after year. In 2014, budgeted OpEx was slightly less than indirect support and support to the service provider.

Figure 18 Recurrent expenditures per capita, 2005–2014



For an exit strategy that involves setting a tariff for financing operation and maintenance by users, both OpEx and direct support to service providers would have to be considered. These two recurrent costs have changed over time but levelled off around $2 per capita per year in 2014.

Figure 19 Operational and direct support expenditures per capita, 2005–2014



The figures are different when based on observed population. Table 21 shows that, with the observed population, the financing of the service by users would reach $6.80 per capita per year and would require $6 per capita per year in indirect support.

Table 21 Reported and observed recurrent costs per capita, 2014

	2014 as reported	2014 as observed
ExDS	$1.25	$3.60
OpEx	$1.10	$3.20
ExIDS	$2.10	$6.00

3.3 Summary

Costs and unit costs for the provision of safe water differ considerably in the two camps, in both capital investment and recurrent expenditures. The investment per capita was $95 in Camp Bambasi, versus just $25 in Camp Kounoungou. In 2014, operation and support cost $8.30 per capita in Bambasi, versus $4.50 in Kounoungou.

In Bambasi, the operational expenditures and the support to service providers were $4 per capita each, almost four times more than in Kounoungou, which spent $1.10 and $1.25 per capita, respectively. The difference in operational costs is mostly attributable to the purchase of fuel for the pipe schemes: it costs $0.50 in operation to provide 1 m3 in Bambasi, versus $0.21 in Kounoungou. The difference in the support to service providers may be related to the camps' ages, the more recent camp benefiting from more financial resources than 10-year-old Camp Kounoungou.

Interestingly, it cost the same in the two camps to operate the water system as to support the service providers. After 10 years, the expenditure on service providers in Kounoungou amounted to the same as the expenditure to operate and maintain the infrastructure. Similarly, unit operational cost equalled unit support cost in Bambasi.

In an exit strategy, both operational and management expenditures would be recovered through a tariff[6]. Based on reported data, the tariff would be $8 per capita per year in Bambasi, versus $2.35 in Kounoungou.

Finally, the expenditure on indirect support was seven times higher in Kounoungou in 2014: provision of water for a refugee cost $0.30 in Bambasi but $2.10 in Kounoungou. In other words, indirect support was a very marginal expenditure in Bambasi, whereas in Kounoungou it was almost the same as the operation and the management of the service. Such a difference is puzzling, but the change in budget formats and the range of activities endorsed by the INGO in Chad, whose overhead costs are partially allocated to the provision of water in this camp, may explain it.

Reported and observed unit costs differed even more drastically because of differences in head counts. In Bambasi, capital investment jumps from $95 per capita based on the registered population to $136 based on the apparent actual population, and in Kounoungou, from $25 to $71. Recurrent costs varied by the same magnitude. In an exit strategy, refugees in Bambasi would have to contribute more than $12 each per year, or $1 per month, whereas in Kounoungou, each refugee would have to pay $6.80 per year, or less than $0.60 per month. Of course, the population of a camp affects not just the provision of water. One might explore incentives for refugees to report reliably on the size of their households. Another alternative is regular censusing of camp populations.

Unit costs in both camps can be compared with benchmarks for regular settlements. Table 22 considers each unit cost component in both contexts, based on registered populations and observed users.

Table 22 Unit cost components for refugee camps and regular settlements

	Camp Bambasi	Camp Kounoungou	Regular settlements in Africa
CapEx			
Reported	$95	$25	$30–$130
Observed	$136	$71	$80–$130
OpEx			
Reported	$4	$1.10	$0.50–$5
Observed	$6	$3.20	$1.70–$3.50
ExpDS			
Reported	$4	$1.25	$1–$3
Observed	$6	$3.60	$4–$6

Benchmarks in regular settlements are what it costs to achieve a "basic" level of service, which has a lower standard for distance and crowding than the above-standard level of service in a refugee context.

[6] This is a conservative assumption, since sometimes tariffs also recover capital maintenance.

4 Conclusion and recommendations

This study comports with UNHCR monitoring outputs in many ways. However, it also identifies gaps and points to opportunities to improve the assessment of service delivery and budget planning.

We have demonstrated that a life-cycle costs approach is applicable to costing water services in refugee camps. LCCA adds value in the understanding of levels of service provided and received by refugees as well as the unit costs and their drivers in both emergency and permanent camp phases, across systems and time.

Because total quantity and quality of water largely drive investment cost, it is crucial to know how much water of what quality is required, based on real demand, so that UNHCR and its partners can determine whether to maintain existing levels of investment per capita, alter the standards or revise the levels of investment.

On service delivery, LLCA adds value by bringing in a demand perspective. It complements the existing supply perspective—monitoring focused on the quantity and quality of the water made available to refugees. Standards are defined by the service to be delivered, in both quantity and quality. Thus, demand-based monitoring that determines the actual quantity and quality of users' water service can help validate the UNHCR standards.

The steps of the service ladder—critical, problematic, acceptable and above standard—allow water service to be assessed per design, as provided and as received. The first two approaches are reported to UNHCR. In both camps, water provision per design is above standard: the infrastructure in place is designed to supply each refugee more than 20 litres of safe water distant less than 200 meters at no crowded taps.

As reported, water provision in Bambasi ranks above standard for all indicators except quality, which is acceptable. In Kounoungou, the service has reached the acceptable level and is even above standard on distance. As observed, however, the picture is different. In Bambasi, only 21% of refugees receive an acceptable level of service, none receive an above-standard service, and 67% fetch less than 10 litres per capita per day and thus receive a critical level of service. In Kounoungou, where only a third of the population showed at water points over four days, the service ranks as acceptable for crowding and above standard for distance, but 20% of refugees receive 10 to 15 litres per capita per day (problematic level), and 45%, less than 10 litres per capita per day (critical).

Overall, the water service is worse in Camp Bambasi, where only 21% receive acceptable service, than in Camp Kounoungou, where 36% get at least an acceptable level, and more than half, above-standard service.

LCCA adds value to the assessment of water service by showing the costs. The use of unit costs in particular is a powerful tool for budget planning. Findings of this report cannot be used as benchmarks, but they provide first figures that must be put in broader perspective through similar analyses of a larger sample of camps and settlements.

The cost of the provision of water in emergency versus permanent phases is revealing. In Bambasi, no capital investment was made during the emergency phase; instead, $41,000 was spent every month to ensure daily delivery of safe water to 12,000 refugees. This is $40 per capita per year, versus $8 for the permanent solution in the form of pressurised water. The investment in the pipe scheme is returned in 44 months because it reduces operational expenses.

Twice as much was invested to build the pipe scheme in Bambasi as in Kounoungou. The former's system was designed to supply a population twice as large as the population registered in 2014, so the investment per capita is four times higher than in Kounoungou, where the system is approaching full capacity. The ratio of OpeX to CapEx ratio is almost equal in both camps (5%). However, for piped water, the operational cost per m3 is $0.50 in Bambasi, versus $0.20 in Kounoungou.

Similarly, for direct support to service providers, the per capita cost in Bambasi is $4, versus $1.25 in Kounoungou. But the amount spent on indirect support in Kounoungou makes up for this difference: altogether, support per capita is the same in both camps.

Based on the observed number of users, however, the capital investment is one third (Bambasi) to three times (Kounoungou) higher than if the per capita investment is based on the reported population. Recurrent costs per capita observed increased accordingly. In an exit strategy, this means that a refugee in Bambasi would have to contribute $12 per year instead of $8, and a refugee in Kounoungou, $6.80 per year instead of $2.35.

Combining service levels and unit costs shows that refugees in Kounoungou receive in average a better and cheaper water service than in Bambasi. In both camps, the unit costs of water delivery stand within the range of the benchmarks that IRC has investigated in small towns in Africa, though the OpEx observed in Bambasi exceeds the benchmark by $2 per capita per year. In both camps, the proportion of population receiving an acceptable or above standard levels of service is much higher than observed in regular settlements, despite the lower standards for refugees.

Recommendations

To be validated, the difference between reported and observed levels of service requires that the demand perspective be included in regular monitoring. Accurate data on actual users and usage are also indispensable for an exit strategy, since refugees would pay according to the volume of water fetched or the size of their households.

The discrepancy between reported and observed volumes of water and population can be tackled through the following approaches:

- Systematically reading meters at the production site (pumps, tanks) and at tap stands
- Adding meters to equipment whose functionality must be reported
- Regularly censusing refugee populations
- Including questions about water demand in monthly household surveys

Last but not least, it is important to replicate the LCCA in a large number of camps to build benchmarks that can ultimately improve budget planning.

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