Full Analysis Report

SUSTAINING WATER SERVICES FOR REFUGEES AND HOST COMMUNITIES IN ETHIOPIA AND UGANDA

a decade of experience

IRC KFW UNHCR The UN Refugee Agency unicef for every child

Acknowledgements

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SUMMARY

The study conducted by the R-WASH Programme (*Regional Water, Sanitation and Hygiene (WASH) Programme for Refugees, Internally Displaced Persons (IDPs) and Host Communities in East Africa*), jointly implemented by UNICEF and UNHCR, examines the development and management of water services in refugee and host communities in Itang Gambella, Ethiopia, and Rwamwanja, Uganda. It highlights the shift towards sustainable, integrated water supply systems, focusing on the challenges and achievements in infrastructure development, service levels, costs, and financing. The study provides insights into the complexities of ensuring effective and sustainable water supply in refugee-hosting areas. It emphasizes the importance of utility-led models, their impact on the communities, and the strengthening of their social cohesion, offering valuable lessons for similar initiatives in other challenging environments. This comprehensive analysis serves as a resource for stakeholders in the WASH sector, especially in areas with significant refugee populations.

Nyayong Koang is a water kiosk operator in Itang, Gambella region, Ethiopia. Nyayong makes a living selling water while serving her community (©UNICEF Ethiopia/2023/Nahom Tesfaye).

INTRODUCTION

Water supply for long-term refugee and host communities

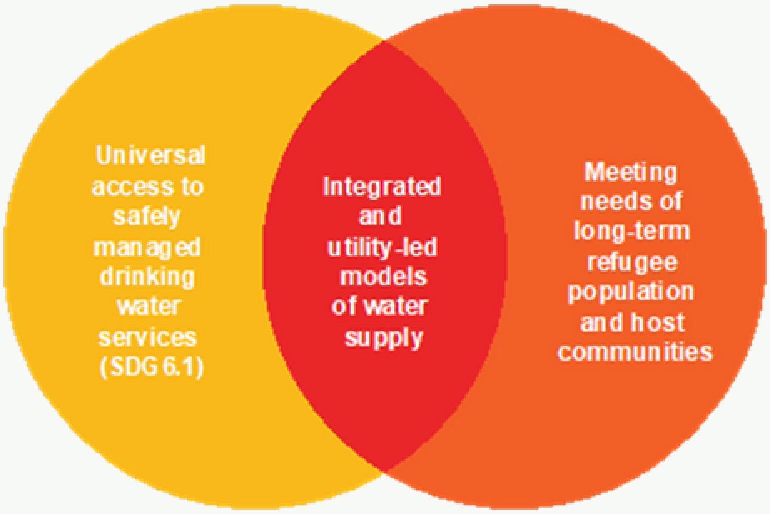
More than 60 per cent of all refugees are ultimately displaced for decades, served by under-resourced humanitarian systems that are designed for short term responses [1]. Children are typically most affected by the negative impacts of refugee crises, as they face numerous challenges, often because they have few – or no – options to move through safe and regular pathways whether on their own or with their families [2]. Moreover, children are dramatically over-represented among the world's refugees. While children make up less than one third of the global population, they accounted for more than 41 per cent of the world's refugees in 2022 [3]. Both in Itang, Ethiopia, and Rwamwanja, Uganda, children account for over 60 per cent of the refugee population [4][5].

Humanitarian water supply interventions that need to be deployed quickly and without further adaptation and development are typically ill-suited to long-term sustainable water services provision. Limited service levels and the relatively high costs of technology options and delivery mechanisms are key constraints. Over time, like elsewhere, water supplies need to evolve in contexts where refugees stay with their host communities for long periods. Piped water supplies provide the highest level of service and are the focus for delivery of safely managed drinking water as envisaged under Sustainable Development Goal (SDG) 6.1. Piped supplies also offer the most potential for economies of scale in service provision, with professional utilities being the most widespread model for management. At the same time as countries seek to extend piped water supplies in line with SDG 6, the parallel challenge of sustaining services to long-term refugees and host communities has been driving interest in the integration of service delivery for refugees and their host communities and the potential of utilities to lead sustained service delivery (Figure). The integration of service delivery is a key factor in promoting social cohesion between refugees and host communities as this approach can provide equal access to essential services to both groups, which can help to reduce tensions and foster mutual understanding. This is especially the case in fragile situations where refugees and host communities may compete for the same limited resources, leading to potential conflicts.

The Itang-Gambella Water Supply Project has been a pioneer in the development of such integrated models for water supply in Ethiopia and the wider region. Key lessons have been the clear preference for utility managed piped supply schemes over water trucking solutions in protracted refugee situations, the feasibility of integration of water supply in areas with large, displaced communities and sizeable host communities, and the importance of having a reliable client like UNHCR to ensure financial stability for a utility. This is particularly important during a transition period until more sustainable financing mechanisms are put in place to bear the water consumption costs.

The development of integrated water supplies for refugees and host communities is now moving forward under the innovative R-WASH programme in the East Africa region (see Box 1). A key challenge in the fragile and vulnerable contexts in which most displaced communities reside is identifying and engaging existing utilities that can extend their services. To establish a utility from scratch, additional time is required for setting up the institution or company and human resourcing it. A further major challenge is developing sustainable financing models for services, including to cover operation and maintenance costs, with considerable pressure on tariffs and payment in such contexts.

Rationale for integrated and utility-led models of water supply for refugees and host communities



Source: Authors

[1] UNHCR/UNICEF. 2020. Blueprint for joint action: case for investment
[2] UNICEF. Migrant and displaced children. [https://www.unicef.org/migrant-refugee-internally-displaced-children, accessed April 2024]
[3] UNICEF Data, June 2023. Child displacement [https://data.unicef.org/topic/child-migration-and-displacement/displacement/, accessed April 2024]
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[5] UNHCR, September 2023. Uganda - Refugee Statistics. https://data.unhcr.org/

CONTEXT

R-WASH | THE REGIONAL WASH PROGRAMME FOR REFUGEES, INTERNALLY DISPLACED PERSONS AND HOST COMMUNITIES IN EAST AFRICA

In a partnership, UNICEF (Eastern and Southern Africa Regional Office, ESARO) and UNHCR (Regional Bureau for the East and Horn of Africa and the Great Lakes) are implementing the innovative Regional WASH Programme for Refugees, Internally Displaced Persons (IDPs) and Host Communities in East Africa (R-WASH) primarily with funding from the German government. The programme aims to establish resilient urban water supply systems for both host and forcibly displaced communities, as well as City Wide Inclusive Sanitation interventions aiming at social cohesion. Water utilities operate the water supply services for communities in an integrated supply service model. R-WASH began in 2021, covering four refugee/IDP camps and host community locations in Ethiopia, Somalia, Uganda, and Sudan and covers now eight locations.

BOX 1

Context in Gambella, Ethiopia

Ethiopia has hosted refugees from neighboring countries such as Sudan, South Sudan, Somalia, Eritrea, and Djibouti since the early 1980s. According to UNHCR, there are currently over 1,000,000 refugees living in the country. Ethiopia has hosted South Sudanese refugees even before the country's independence in July 2011, but the numbers seeking refuge have increased steadily since 2014 as a result of civil war (2013-2020). By May 2024, there were 394,000 South Sudanese refugees in the Gambella region of which 62 per cent where children. These refugees are primarily hosted in seven camps, with 62 per cent living in the three camps of Kule, Tierkidi and Nguenyiel located close to the town of Itang, Gambella. Itang lies near the Baro river, a major White Nile tributary that flows westwards towards South Sudan.[4]

The Government of Ethiopia joined the Global Compact for Refugees (GCR) in 2018 and has since adopted gradually a more inclusive approach in hosting refugees by ensuring that the fundamental needs of both the host communities and the refugees are met, including access to WASH services, in an integrated manner. Joining the GCR has been instrumental for paradigm shift to a utility managed model for water service provision in refugee-hosting areas. In the camps all the necessary support to maintain a dignified standard of living are provided by UNHCR, WFP, UNICEF, and international implementing partner agencies in close coordination with the government of Ethiopia's Refugees and Returnees Service (RRS).

Food for the refugees is provided by WFP, while shelter, health, water supply, and sanitation needs are covered by various INGOs under the coordination of UNHCR and RRS. Water, sanitation, and hygiene services for the refugee communities within the three camps have been provided through several implementing partners in partnership with UNHCR and RRS.

Context in Rwamwanja, Uganda

By May 2026, Uganda was hosting over 1,600,000 refugees, equivalent to 3.5 per cent of the country's total population6. These refugees mainly come from the Democratic Republic of Congo (63.3 per cent), South Sudan (32.4 per cent), and Somalia (4.3 per cent). The refugee population has put immense pressure on Uganda's already stretched capacities and resources, with the population of refugees increasing from 1.1 million in June 2017 to 1.5 million in September 2022. An average of 9,800 new refugees arrived every month between May and October 2022 alone.

To address this challenge, the Government of Uganda (GOU) included refugee management and protection in its second National Development Plan (NDP II) 2015-2020. It shifted its focus from a solely humanitarian approach to recognizing the linkage between humanitarian and development, recommitting to maintaining its open border policy. In 2017, the GOU joined the GCR and launched the Comprehensive Refugee Response Framework (CRRF) in the country, fostering stronger cooperation among a broad array of stakeholders.
Under NDP II, both refugees and host communities should have assured access to adequate water of good quality, sanitation facilities, and hygiene promotion practices. The Office of the Prime Minister in partnership with UNHCR, UNICEF and WFP coordinates the delivery of services in refugee settlements.

Planning for refugees is included in national systems to enable them to access services, and innovative approaches are used to prepare both new arrivals and the established populations to achieve self-reliance.

The Rwamwanja refugee settlement is located in Nkoma Katalyeba Town Council in Kamwenge district in Midwestern Uganda. It has a history of hosting refugees that dates back to 1964 when it was established to accommodate refugees from Rwanda. The settlement was closed in 1995 but was reopened in April 2012 to host refugees fleeing the violence in North and South Kivu in the Democratic Republic of Congo (DRC). The settlement is bordered by the Katonga Wildlife Reserve to the south and is about 80 km from the border to the DRC in the west. According to UNHCR data, the settlement hosted 92,764 refugees in September 2023 of which 62 per cent were children [6]. In comparison, the host community's population was 39,545 people. The refugee population is more than double that of the population in Nkoma Katalyeba. According to UNHCR (2022), 55 per cent of the refugee population have an occupation, of which 55 per cent engage in field crop and vegetable farming and 34 per cent engage in mixed crop and livestock farming.

[6] UNHCR. September 2023. Uganda - Refugee Statistics September 2023 - Active Population by Settlement. . https://data.unhcr.org

METHODOLOGY

This study summarizes the assessment of recent experiences in transitioning water supply arrangements in contexts with long-term refugee populations. Two case studies are described from locations with integrated models to serve refugees and host communities, and where there has been a transition to management by utilities. These are: the case studies from Itang in Gambella, Ethiopia; and from Rwamwanja, Uganda.

This study aims to provide a deeper understanding of the costs of water production and distribution in these cases, as well as possible efficiencies through water metering, billing, and revenue collection. It also provides options and recommendations for financing, seeking to further improve the sustainability of integrated arrangements and utility-led models (see Box 2).

The Itang case study is broken down into three major phases seeking to identify how levels of service and costs have changed as various solutions to water supply have been developed. The Rwamwanja case study is also broken down into two phases, although it makes less of a distinction between the phases.

This is a limited study, which was mainly desk-based with few site visits and interviews, that sought to collate and draw on a large amount of existing data held by different stakeholders. The research methodology was built around four steps linked to key research questions: (i) gain an understanding of the development of infrastructure and service delivery models; (ii) establish estimates for service levels; (iii) gain an understanding of the economic landscapes of service delivery; and (iv) develop learning and recommendations.

KEY RESEARCH QUESTIONS

Infrastructure development and management models

What infrastructure facilities have been constructed in each case, and how have the schemes been managed?

Service levels for refugees and host communities

How have service levels changed as a result of investments in infrastructure and developments in management in a context where the populations served are dynamic? This included estimating and comparing the volume of water supplied as well as assessing data on other indicators such as functionality of facilities, water quality or distance to access water.

Costs of service provision

What was the full cost of delivering water services to refugee camps and their host communities in Itang, Ethiopia and Rwamwanja, Uganda? This includes costs from earlier supply methods such as water trucking (Phase 1) and NGO-led bulk supply (Phase 2).

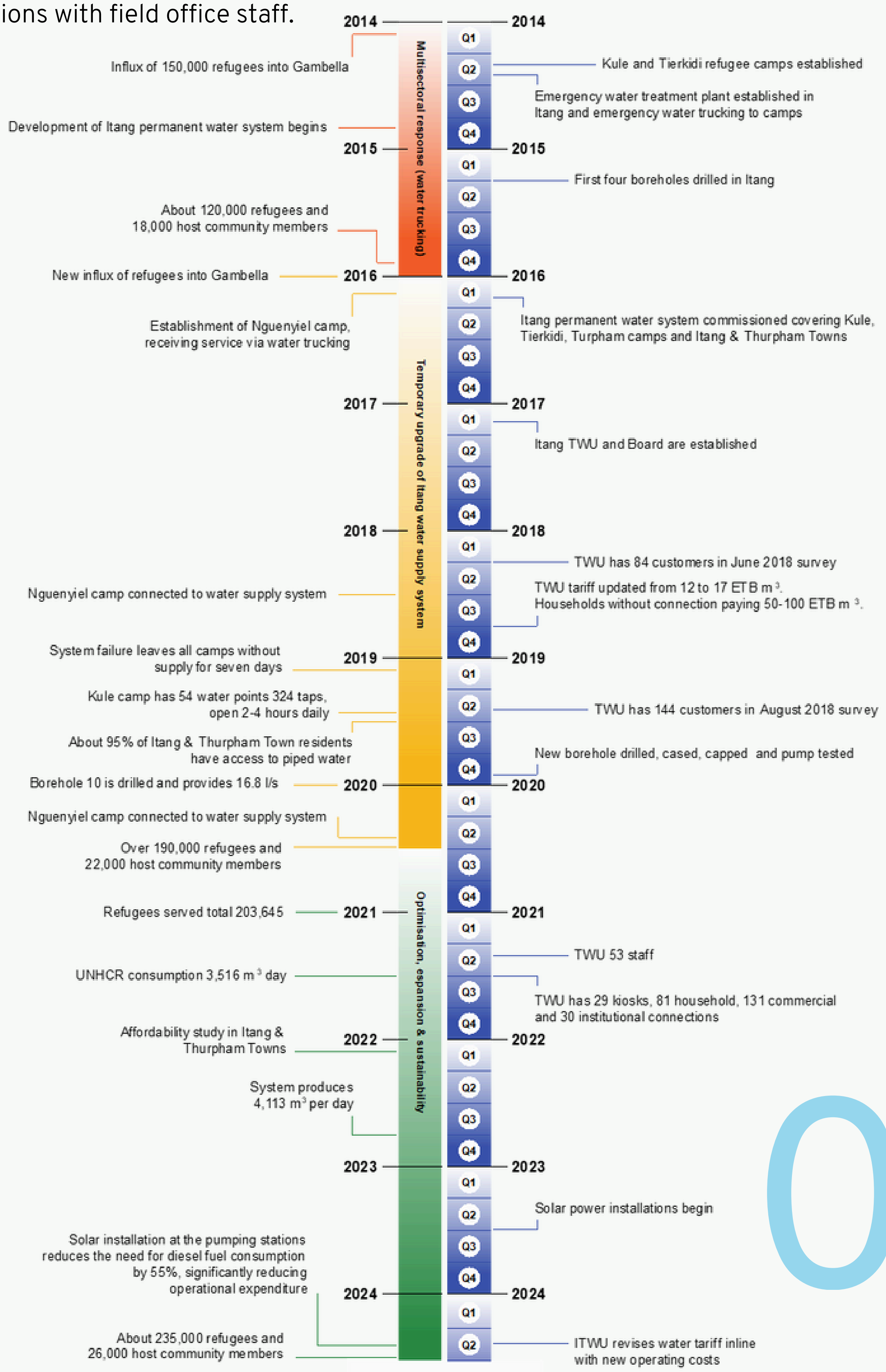
Financing

How were the costs covered in existing integrated models, and what options are there to improve the sustainability of long-term financing of service delivery?

BOX 2

Gain understanding of the development of infrastructure and service delivery models

A timeline was compiled for Itang and Rwamwanja identifying and describing the different phases of water service delivery. The figure below shows the Itang timeline. For Itang, three distinct phases were identified. These were used as the basis for the subsequent assessment of service levels and costs. This was done by undertaking a review and analysis of existing information, including reports and datasets obtained from UNICEF and UNHCR, and was complemented with initial discussions with field office staff.



Note: TWU: Town Water Utility; ETB: Ethiopian Birr; ITWU: Itang Town Water Utility

Establish estimates for service levels

For each of the service delivery phases established in Step 1 (Gain understanding of the development of infrastructure and service delivery models), estimates were compiled for the service provided, including the volume of water supply. Where possible, the volume of water produced, and the volume of water supplied to the camps and host communities were estimated. This was done in part through a review of existing and available data (reports, datasets) obtained from UNICEF, UNHCR, and other NGOs that have worked in the camps and host communities and was complemented with insights generated through key informant interviews and, where possible, on-site observations. For each of the service delivery phases, areas of interest and indicators included:

- the total number of water schemes in service for the camp and host community, disaggregated by type of scheme and technology;
- the percentage of functional, partially functional, and non-functional water supply schemes, disaggregated by type of scheme and technology;
- the estimated average quantity of water supplied from scheme (litres per person per day, LPD) calculated from yield, hours of operation, and number of users;
- average quantity of water consumed (LPD) calculated from data on volume collected and household size;
- estimated maximum distance travelled for water collection;
- average time taken for a round trip to collect water;
- an estimate for water quality, based on service delivery model, known management practices, and any available biological water quality test data;
- the number of people using safely managed drinking water sources; and,
- the reliability of the service.

Gain an understanding of the economic landscapes in service delivery

Building further on the current and historical service delivery models established in Step 1, we aimed to construct estimates for the cost of delivering water to the camps and host communities. This was intended to enable a range of comparisons between the locations, the service delivery models, and the camps and host communities. A life-cycle cost analysis was used as a framework for data collection and analysis. This was completed in part through the review of existing and available data (reports, datasets, contracts) obtained from UNICEF, UNHCR, and other NGOs that have worked in the camps and host communities and complemented with insights generated through key informant interviews and, where possible, on-site observations. For each of the service delivery phases, data points of interest included:

1. Cost and/or value of existing infrastructure
2. Actual expenditures (utility, local government, UNICEF, UNHCR) on direct support, operational expenditure
3. Tariffs and affordability (including revenues or recovery)

Learning and recommendations

The analysis enables some comparisons to be made between Itang and Rwamwanja, between service delivery models, and between the camp and host communities. Findings were also assessed against benchmarks from other studies and recommendations developed to improve further assessment and learning including volume analysis of water supplied. Finally, we identified some possible scenarios for financing, which is a priority area for future innovation.

RESULTS

Water supply in Itang, Gambella, Phase 1: Multi-sectoral emergency response (2014-2016)

Infrastructure

Prior to 2014, the communities in Itang and Thurpham towns relied on wells with handpumps and surface water. With the arrival of refugees in far greater numbers than the size of the host community (about 120,000 refugees and 18,000 host community members), a larger, systematic arrangement for water supply had to be rapidly established. Phase 1 can be divided into two distinct phases: first, surface water abstraction from the Baro river (located 15-18 km from the camps) with treatment and trucking, followed in Phase 2 by the development of four boreholes complemented by continued trucking of treated surface water. By the end of Phase 1, seven boreholes had been installed and were supporting a large-scale water trucking operation for the camps.

In 2014, an extraction system using the Baro River as a source with four surface pumps was developed. Later in 2014 the first boreholes were drilled, and by early 2017 there were seven boreholes constructed along the embankment of the Baro River near Itang town. Six were drilled by the International Rescue Committee (IRC) and one by World Vision but transferred to IRC for operation and management. The water system during Phase 1 suffered from low functionality and regular generator set issues requiring nearly continuous maintenance.

Each of the first boreholes, drilled in July 2014, were estimated to produce 9 l/s and pumping to last 12-15 hours every day. IRC tested six boreholes which were shown to produce between 9.4 and 12.2 l/s. Each borehole produced between 389 and 486 m3 and collectively produced between 1,555 and 1,944 m3 per day. Later, with the fifth and sixth boreholes drilled, new pumping tests concluded that boreholes 1-4 yielded 9.4 l/s and boreholes 5-6 yielded 12.2 l/s. The expected safe yield of all pumps ranged between 10 and 15 l/s.

The total water production for the whole month of March 2014 was only 1,960 m3, increasing to 40,758 m3 for the month of December 2014, when the daily average totaled 1,359 m3. The total production in this 10-month period was 231,672 m3, representing an average daily production of 778 m3.

Phase 1 involved trucking water from the Baro river and boreholes located near Itang

Source: Authors

The water source for Kule and Tierkidi camps was the same but the transportation (trucking to the camps) was managed separately. By July 2014, 15 trucks were in operation, collectively making 650 trips and delivering 12,666 m3 of water to Kule camp. By December 2014, Kule camp was being serviced by 13 trucks, with a total combined capacity to transport 241 m3. Between July and October 2014, the number of trips and volume transported fluctuated, increasing to 928 trips and an estimated 17,738 m3 of water delivered in a month. Later, in May to August 2015, a total of 15 trucks were delivering up to 23,424 m3 per month, and by October 2015 an estimated 26,054 m3 of water was supplied over 1,357 deliveries, implying a supply to Kule camp of 868 m3 per day. The piped system in Kule camp was commissioned in January 2015. However, some parts of the camp continued to experience water problems, therefore small-scale water trucking (one to two trucks) continued until December 2016.

Although water volume data was unavailable for Tierkidi camp, the trucking volume was similar. Trucking began in April 2014, with four trucks daily, increasing to 13 trucks by October 2014 and 15 by January 2015, which continued at the same level of supply until December 2015.

Infrastructure developed during Phase 1 included the emergency water treatment facility, four generators, nine pumps for the collection chamber, a first booster station, components for the pressure line, electrical components, water storage tanks, submersible pumps, water meters, high density polyethylene (HDPE), polyvinyl chloride (PVC), and galvanized steel (GS) pipes, and civic buildings for pumping stations, guard houses, toilets, pump houses, gates, and fences.

Services

In July 2014, the population of Kule Camp was 41,783 and the daily volume of water supplied was less than 400 m3 per day, accessed from fewer than 150 taps. The implied average supply was 9.6 LPD excluding losses. Oxfam measured and recorded the total volume supplied to Kule Camp, which increased from 15,011 m3 in the month of July 2014 to 19,859 m3 in February 2015. Based on the recorded Kule camp population throughout this period (which remained fairly constant, fluctuating between approximately 46-50,000 people) the available water supply ranged from 9.5 to 15.3 LPD. In 2014, Tierkidi camp is believed to have received the same level of service.

When the system extracted water from the Baro River through four surface pumps, water was treated by chlorination using chlorine granules. Water quality was tested periodically for residual chlorine up to the point of use; turbidity was monitored; and, sedimentation in tanks tested. However, during Phase 1 the principle of ‘quantity first’ applied, and there was a ‘drastic lack of safe water’. Throughout Phase 1 the host community in Itang and Thurpham towns depended on hand dug wells located in Itang and surface water from the Baro River. A 2016 affordability study found 73 per cent of sampled households used hand dug wells as their main source of drinking water, and households paid different amounts for water. The significant majority of households in Thurpham paid between ETB 8-10 ($ 0.42 – $ 0.53, 2022) per jerrycan, reflecting the significant distance travelled by vendors, whilst Itang residents typically paid between ETB 0.5 and 4 ($ 0.03 – $ 0.21 2022) per jerrycan. Over 95 per cent of the residents in Thurpham reported that the water was not affordable, compared to less than 20 per cent in Itang town. Residents in Itang and Thurpham reported typically spending between 3-5 per cent of their household income on water.

In the same period, a separate study (Zenas, 2016) found the majority of households in Itang spent less than 30 minutes obtaining drinking water from the hand dug well sources that were mostly within 500 metres of the households, while 98 per cent of respondent households in Thurpham spent more than an hour fetching water, with no residents living within 2.5 kms of a water source.

Costs

Contracts and invoices from the water trucking operation in 2015 show average monthly costs of at least $ 103,000 (in USD 2022 equivalent).
The cost of trucking water was significant. In Kule in 2014, over $760,000 (USD 2022) was spent on trucking, which includes the distribution cost of trucks, daily subsistence allowance and fuel, but does not include the cost of infrastructure or water production. This increased to $1,592,870 (USD 2022) in 2015 when the trucking operation was in full operation. In 2016, when the sustainable system entered operation, a smaller number of trucks still operated, costing $152,761 (USD 2022). The total cost for trucking water to Kule is estimated to have been $2.505.660 (USD 2022).

Similarly, in Tierkidi, which received a similar level of water trucking service, the cost was estimated to total $768,580 (USD 2022) in 2014 and $1,579,778 (USD 2022) in 2015, totaling $2,348,358 (USD 2022) for trucking during Phase 1.
The combined cost of water trucking to Kule and Tierkidi in 2014-15 totaled an estimated $4,854,018 (USD 2022). However, this figure only includes the cost of transport and does not include the range of water production costs.

The investment costs and source of finance for the water supply system were compiled from UNICEF and other partners. In Phase 1, the total investment costs were ETB 106,918,000, of which UNICEF with donor funding covered 79 per cent while the remaining 21 per cent came from donations by UNHCR, IRC and World Vision. In 2014, the USD cost was $ 5,411,109. The inflation-adjusted cost was $ 6,904,060 (2022).

If we estimate that 50 per cent of the investment costs ($ 3,452,030) were required for the water production to supply the water trucking operation, the total cost for the water trucking service during Phase 1 will have been an estimated $ 8,306,048 (USD 2022). This resulted in an estimated daily average supply of 1,000 m3 (the range was between 778 and 1,900 m3). Since the life cycle of the water trucking operation for Kule and Tierkidi was only two years, this comes to a cost of $ 11.38 per m3. However, much of the infrastructure used in Phase 1 remained operational during Phase 2-3. The water distribution costs alone (which includes the cost of trucks, daily subsistence allowance and fuel) during Phase 1, without including any infrastructure or water production costs, were $ 6.65 per m3 (USD 2022).

BY THE END OF PHASE 1

- Number of beneficiaries: approximately 120,000 people in camps and 18,000 in host community
- Water transportation: 100 per cent trucked
- Boreholes producing water trucked to the refugee camps, complementing hand dug wells and surface water used by the host community
- Estimated water supplied to refugees in the range 9.5 to 15.3 LPD

Estimated cost of water trucking: 11.38 per m3.

BOX 3

Estimated costs for establishing infrastructure for the proposed 'sustainable solution' included: the design of the system; drilling and equipping boreholes; genset and fencing; laying pressure mains, connection wells and master storage reservoirs; construction of elevated storage tanks, connection to master storage tanks and laying piped networks in camps; construction of yard tap stands and connection to institutions in Itang town; in addition to support activities including capacity building. Although these costs were incurred in Phase 1, they can be assumed as costs for the service delivered in Phase 2-3.

Water supply in Itang, Gambella, Phase 2: Expansion of piped system and NGO-led operations (2016-2020)

Infrastructure

Phase 2 was characterized by the development and implementation of a comprehensive water supply system supported with seven boreholes positioned along the Baro River and covering over 20 kilometres of main pipeline serving four destination areas (the camps and the host community). It included transmission and main lines made of HDPE with different diameters and lengths. The transmission lines run from the collection chamber to the Itang elevated tanker; from the collection chamber to the booster station transfer reservoir; and then to the Thurpham junction community reservoir, Tierkidi Kule and Nguenyiel camp overhead reservoirs. The HDPE material and diameters for the different lines are 100 mm (1,200 m), 250 mm (8,000 m), and 200 mm (4,730 m) for the collection chamber to transfer reservoir, and transfer reservoir to Tierkidi reservoir respectively. Nguenyiel camp was established in October 2016 and the Nguenyiel camp water system was commissioned in August 2018. Between the opening of Nguenyiel camp and the establishment of the Nguenyiel camp water system the camp relied on water trucking, starting with 3 trucks operating daily in late 2016, and concluding with 21 trucks delivering water to the camp in mid-2018.

During Phase 2 there was no power grid system for the pumping stations at the sources and booster stations, so diesel fuel was used to run the generators. There were three generator houses in total, each with a couple of generators used to lift water from the boreholes. At the collection chamber, there were two units of 130 KVA generators coupled with surface pumps to relay water to the booster station located at the junction area of Thurpham. In Thurpham, the booster station was equipped with two heavy generators to pump water to the reservoirs in the refugee camps.

The water supply system included several service buildings such as generator houses, pump houses, booster pump buildings, and guard houses.

The water supply system overall was equipped with 27 high discharge pumps and 20 generators, storing up to 7,750 m3 and supplying 3,500 m3 of water per day. Recorded figures for water production between September 2017 and May 2018 show a monthly production ranging from 90,855 to 127,964 m3. The total water produced in nine months was 969,755 m3, giving an average daily production of 3,590 m3. Between January and September 2018, the daily average runtime for each of the five functioning generators ranged between 1.3-14.2 hours daily, where the average runtime across the functional boreholes was 9.6 hours a day.

The water distribution facilities included water kiosks, public water points, and hydrants for water trucking. The three camps were equipped with 200 public taps and 57 institutional connections, and they received 77 per cent of the water produced from the system, with a single institutional billing to UNHCR from the main bulk meter to each of the camps. The host community was supplied with 23 per cent of the water produced, which was distributed through 22 kiosks and 130 institutional connections, and the billing was based on individual consumer meter readings.

The functioning of the generators remained a challenge, and three of the seven boreholes were frequently not in operation.

Services

The Itang Town Water Utility (ITWU) was established in 2017 to manage the water supply system. The 2017 ITWU Business Plan estimated that Kule and Tierkidi refugee camps were receiving 14 to 15 LPD. At the same time, a study by the International Rescue Committee (2017) found water consumption had increased in Kule camp from 11 to 16 LPD and in Tierkidi camp from 11.5 to 15 LPD. Later estimates (2019) calculated that the system supplied between 15 to 17 LPD for the people residing in the three refugee camps and the host communities.

In 2016, there were seven operational boreholes with 23 generators in a three-stage pumping system and plans to connect to the national grid were underway. However, most of the generators were in disrepair due to age, lack of spare parts, and long operating hours. The system was overstretched because of insufficient water sources (hence requiring long pumping times), a lack of operational backup pumps and generators, and a shortage of spare parts and tools. These challenges led to the breakdown of generators, pumps, and main pipelines, causing water supply interruptions to beneficiaries.

In the 2017 ITWU Business Plan, water loss was estimated at 10 per cent. Similarly, IRC estimated that water loss due to leakages at that time was around 10 per cent. It was estimated that these losses would rise to 15 per cent over the planning period, up to 2021. In 2018 the ITWU established a flat tariff of ETB 11 per m3 ($ 0.49 2022). In the host community, residents in Itang paid ETB 0.5 per jerrycan and residents in Thurpham paid ETB 2 per jerrycan (ETB 100 per m3). An affordability study commissioned by UNICEF in 2018 showed that refugees were accessing water from public water points strategically located within the camps at reasonable walking distances of less than 250 m from the dwellings. The Nguenyiel camp trucking operation, between October 2016 to August 2018, cost an estimated total of $1,846,189 (USD 2022).

In May 2020 the ITWU was planning services for 207,568 people. The population of the host community was 26,340 (13,340 in Itang and 13,000 in Thurpham) representing about 12 per cent of the population in the utility service area. The collective population of the three camps was 192,527, with 64,409 people in Tierkidi, 45,385 in Kule, and 82,733 in Nguenyiel.

Phase 2 involved pipelines connected to the well field on the Baro River to the three camps as well as Itang and Thurpham (secondary networks are not shown)

Source: Authors

Costs

The ITWU Business Plan (2017) contains a list of costed items and their prices in ETB, compiled from UNICEF completion reports, the UNICEF Gambella Field office, World Vision and IRC Project offices. Items include pipe works, steel and pioneer tankers, buildings, electro-mechanical units, spare parts, data loggers, borehole drilling and pumps, public taps, access road, and Phase 2 optimization work. In 2017, the total investment for the Itang water supply project was ETB 202,530,088. The USD cost at the time had been $ 8,686,596 and the inflation-adjusted cost was $ 10,022,438 (2022).

In 2017, ITWU staffing costs totaled ETB 496,974 ($ 24,593 2022) and by 2018, they had risen to an estimated ETB 2,021,794 ($ 89,212 2022). In 2018 Oxfam estimated the total operating costs of the water supply system at $ 1,083,941 ($ 1,259,436 2022). According to a 2018 sustainability audit, expenses included salaries, pension contributions, daily labour, personnel, initial office setup, office operating costs, office rent, fuel for generators, fuel for Itang, oil for generators, oil for Itang generators, treatment chemicals, treatment chemicals for Itang, materials, supplies, parts, other expenses, repair and maintenance costs, water quality test, and transport including two motorbikes. In 2018, the total annual operational expenses amounted to ETB 10,468,979 ($ 461,945 2022).

The combined Phase 1 and Phase 2 capital expenditure was $ 16,957,213 (2022). This investment led to the production of 3,590 m3 per day. This quantity can supply 25 LPD for 143,600 people. If we estimate the life cycle of the Phase 2 system to be 20 years (10 years longer than the multi-sectoral emergency response in Phase 1), and use Oxfam's estimate for the OpEx, the system during Phase 2 produced water at $ 1.61 per m3.
According to the joint assessment report of February 2019, there was ongoing resource mobilization for investments on sustainability options for the Itang water supply system, including backup equipment like pumps and generators as well as alternative power options like electric grid and solar systems. The report also states that investment in the project amounted to approximately $ 10 million.

In the host communities a 2019 review found the main source of drinking water was kiosks and vendors, accounting for 69 per cent of the total. The report found that the most affected community groups regarding the water fee were those who were unconnected. These are typically poor families who are forced to buy water from individual vendors at a high cost, with a jerrycan costing ETB 2 in Itang and ETB 1 in Thurpham. This means that the cost of one cubic metre of water was between ETB 50 and ETB 100 ($ 1.96 to $ 3.92 2022), which is significantly higher than what is assumed in the ITWU Business Plan

BY THE END OF PHASE 2

- Number of beneficiaries: approximately 192,561 people in three camps (Kule camp 45,397, Tierkidi 64,420, and Nguenyiel 82,744) and 22,000 people in the host community
- Water transportation: 100 per cent pumped through diesel power
- Seven boreholes with storage and pumping through an extensive distribution network to three camps and the two host communities
- Estimated water supplied to refugees in the range of 15-17 LPD
- Investment costs totaling almost $ 17 million, with an estimated cost per m3 of $ 1.61

BOX 4

Water supply in Itang, Gambella, Phase 3: Utility management and sustainability (2020-present)

Infrastructure

At the beginning of Phase 3 the water supply system comprised 10 boreholes, eight of which were functional, powered by 23 generators. Further system development and expansion included electrical grid connections at all pumping stations and system solarization. Transmission and distribution pipes conveyed the water to collection chamber, booster station and service reservoirs, with two pump houses and generators serving the booster station. Service reservoirs, mostly pioneer tanks, stored water for supply to beneficiaries, along with two elevated concrete reservoirs located in Itang town.
By 2020, the conveyance system consisted of transmission and distribution pipelines extending from the borehole area along the Baro River up to the collection chamber, and from the collection chamber via the booster station up to the service reservoirs. The distribution line extended from the service reservoir up to the public water points. The collection chamber had several reservoir tanks of different sizes. After water was collected in those reservoirs, it was pumped to the next booster station and Itang town balancing reservoirs. In this station, two pump houses with generators were providing service.

At the booster station, the water was pumped to the service reservoirs located at the highest points in the beneficiary areas of both the refugee and host communities and was stored there to supply water to the beneficiaries. Most of the service reservoir structures were made to be pioneer tanks, except for two elevated concrete reservoirs located at Itang town. The concrete reservoirs were 24 m high and had a capacity of 100 m3. Each elevated reservoir was located in different parts of the town. The system had a total water storage capacity of 7.75 million litres. The system managed water storage across 28 reservoirs distributed among the collection chambers, Itang town, Thurpham booster station, Thurpham town, and the three camps, and had a total capacity of over 4,000 m3.

As of February 2020, three additional boreholes were drilled and connected to the pioneer tanks in Kule, Tierkidi and Nguenyiel. Additionally, power grid connections had been established at the collection chambers and booster station. By April 2020, the tenth borehole had been installed with a submersible pump but was not yet connected to the system, while a previous borehole was also pending installation of a submersible pump and connection to the system. In 2023, water production was further strengthened through the introduction of a solar system at both the Itang collection chamber and booster station and will provide power to surface pumps of 704 KW total power. The solar system at the collection chamber powered by 333 kW of solar PV capacity has been handed over and is operational, while the solar system at the booster station has not yet been connected. This intervention will address challenges relating to the shortage of and inconsistent access to fuel and the rising cost of fuel.

The ITWU Business Plan was updated in 2020 and the estimated production ranged between 2,200 m3 in January 2019 and 3,000 m3 in April 2020. At the same time, UNICEF pump test results revealed two of the boreholes had discharges below the recommended yield of 9 l/s and another two boreholes exceeded the recommended yield. Further pump tests for all 10 boreholes performed later in 2020 revealed a range of discharge of between 1.5 l/s and 16.8 l/s. The average discharge from the 10 boreholes was 9.48 l/s.

In May 2020, the Technical Working Group (TWG)[7] minutes recorded that the current bulk meter was faulty, but the system was expected to supply 3,500 m3 daily. However, according to a Hydrological Study conducted in July 2020, the estimated 12-15 hours of utility pumping operation resulted in a daily production of only 2,200 to 2,400 m3 from the seven operational boreholes.

By May 2021, one of the boreholes was still not connected due to low discharge. The main bulk meter from the collection chamber for the Kule Tierkidi line was reportedly permanently submerged, even during the dry season, resulting in the utility not knowing the actual amount of water pumped to the booster station. At this point in time the ITWU relied only on pumping hours to calculate volume.
More recent data, between January and September 2022, shows an average monthly water production of 106,560 m3 and a total production of 959,044 m3 during the nine-month period with an average daily volume of 3,552 m3. Production has since increased to an average of 4,113 m3.

The functioning of the water system remained a significant challenge during Phase 3. The system was overstretched because of insufficient water sources (hence requiring long pumping times), a lack of functioning backup pumps and generators, and a shortage of spare parts and tools. The resulting breakdown of generators, pumps, and main pipelines increased water supply interruptions to beneficiaries.

In February 2020, documented challenges with the water system include frequent generator breakdowns; suction problems in the collection chamber for the Nguenyiel line; vandalism of the Tierkidi distribution line and of the borehole cables in Itang; reduced pumping hours due to insecurity in Itang; a burst pipe in the Nguenyiel main pipeline; a water imbalance between Kule and Tierkidi due to the pump installation arrangement; and at least one borehole not in operation. By April and May 2020, a number of boreholes and generators were not operational due to a lack of spare parts, and supplementary emergency water trucking had started to address water scarcity in remote areas during the COVID-19 pandemic.

The water for trucking was supplied from the emergency surface water treatment plant set up along the Baro river in Itang. As of July 2020, eight out of ten boreholes were in operation, but there were technical problems, including a lack of power supply and the absence of a submersible pump for at least one borehole. The ITWU Climate Resilient Water Safety Plan (2020) reported that inadequate water supplies in the area was due to problems with electro-mechanical equipment, poor outlet pump manifold arrangements, and cavitation on pumps. In October 2023 the solarization of the system began, with installation first at the collection chamber and later, in 2024, at the booster station.

[7] The Technical Working Group (TWG) is a group of experts and stakeholders representing the different beneficiary communities, the government institutions, the utility, the contractors, consultants, implementing NGOs, UNICEF, IOM and UNHCR, which convenes regularly to provide advice and support for the implementation of the Itang water supply system and the overall WASH service delivery to the refugees and their host communities.

Services

Records managed by the ITWU show that there were 111 household connections, 80 commercial connections, 30 institutional connections, and 28 kiosk connections in the host community in 2020. In the camps, the number of public tap stands had increased to 324 in Kule, 600 in Nguenyiel and 300 in Tierkidi. Later, by March 2021, records show the number of commercial connections in the host community had increased to 121.

In April 2020, the ITWU documented that the water supply to Kule camp met the 2020 target of 15 LPD but noted that the supply to Tierkidi and Nguenyiel camps was below the target level. At the time there was a significant imbalance in the water supply, with discrepancies between the three camps, and between the camps and the host community. Factsheets published by UNHCR show refugees in Tierkidi camp received 10.2 LPD in April 2020 and refugees in Nguenyiel camp receiving 16.4 LPD in May 2020 [8]. According to ITWU data, by December 2020 the water system was providing access to 222,561 people, of which 90 per cent were refugees and 10 per cent were host community, meeting UNHCR minimum standards of 15 LPD in all camps.

Water supply data recorded by Oxfam between July and September 2022 show the monthly average supplied to Nguenyiel camp was 49,910 m3, Kule camp 22,303 m3, and Tierkidi camp 30,213 m3. Later, data recorded between September 2022 and June 2023 show that the average monthly water supply to Nguenyiel camp had increased to 51,178 m3, whilst supply to Kule and Tierkidi camps had both decreased (21,641 m3 and 23,203 m3 respectively). During this period the water available for consumption can be estimated at 15.19 LPD in Nguenyiel, 13.77 LPD in Kule, and 10.76 LPD in Tierkidi camp.

According to a 2020 water chemistry analysis (UNICEF Hydrological Study, 2020), the water quality in the area was very good. Additional information on water quality available in Technical Working Group documentation (2020) shows that the water quality situation in Thurpham has improved significantly, but that there are still issues in Itang town and the camps. At the time there was no chlorine disinfection for the water supplied to Itang town. However, the utility was taking steps to improve the situation by re-installing a chlorinator at the collection chamber to serve one of the host community lines. In addition, they planned to procure another chlorinator for the second host community line at the booster station.

[8] UNHCR Ethiopia. 2020. Gambella Camp profile - Tierkidi refugee camp April 2020. [https://data.unhcr.org/en/documents/details/76453] and Nguenyiel refugee camp May 2020. [https://data2.unhcr.org/en/documents/details/77009]

However, in April 2020, documentation by the ITWU reveals the absence of a water quality expert at the utility and un-chlorinated water being supplied to the community in Itang town. Further information in the ITWU Climate Resilient Water Safety Plan (2020) shows multiple water quality concerns across different locations. At the well field and reservoirs, there were water quality problems due to contamination from the river and the absence of disinfection processes. There were problems with pipe breaks and poor wellhead completion, which allowed contaminated surface water to ingress into boreholes. There were also issues with back siphonage and ingression of contaminants due to leaking pressure line pipes and fittings, the absence of check valves, and the low attenuation capacity of unsaturated soil. Human and animal access to borehole sites also led to contaminated water sources.

In the system's collection chamber there was risk of cross contamination due to poor functionality of tanks and immersion of suction hoses of water trucks. The absence of regular cleaning and disinfection of service reservoirs was believed to potentially result in poor water quality. The absence of a treatment system also meant that potentially contaminated water could be supplied to the Itang community. The Thurpham booster station experienced water supply contamination from an old and leaking emergency reservoir, leaking valve chambers around reservoirs, and contamination from bird faeces. The Water Safety Plan (2020) concluded the refugee and host communities were supplied with unsafe water due to an unregulated manual chlorination system and recommended remedial measures.

In Itang town there were no water quality issues found during testing. However, there were potential water quality risks identified and mitigation measures developed.

More recently, ITWU data recorded from booster station monitoring points in August and September 2021 in Kule, Tierkidi, and Nguenyiel show average turbidity of 4.9 nephelometric turbidity units (NTU) and average free residual chlorine of 1.6 mg/l. Both of these results fall within the WHO guideline standards.

Despite persistent challenges in ensuring improved quality water supply, the perception of water quality had improved and 73 per cent of respondents described the water quality as 'good' during data collection for the Itang Town Affordability Study (2021). In the same study, 49 per cent of respondents said the distance from the household was 'not far'. In addition, an increasing number of residents reported receiving water directly to their house, either through household connections or mobile vendors. A total of 78 per cent of respondents reported that they pay for water, and one to three people in each household collect water daily.

About 52 per cent of households stated that they could afford the connection fee to receive household supply. However, the majority of families pay an average of ETB 50 ($ 1.36 2022) to transport water from the source to their houses, which is usually done by other individuals than family members. Typically, families order water on a per-day basis, and the number of jerrycans required is greater than four.
In 2020, water service reliability remained a major issue in several areas. The water service reliability was impacted by various issues relating to generator breakdowns and burst pipes. In Thurpham, external pressure and competing uses by refugees and host communities led to intermittent water supply, while illegal connections and operational limitations led to inadequate supply. The Thurpham booster station also experienced intermittent supply due to cavitation and the absence of a standby generator, and sudden system failures because of the absence of a standby pump. Water scarcity was also a problem in Tierkidi camp due to separate management and operation systems. In Nguenyiel camp, pump cavitation and the absence of a standby generator caused intermittent supply, while high demand and low supply caused water scarcity. In Kule camp, the absence of standby pumps and system manifolds caused intermittent supply, and exposed pressure pipes cut by people during social conflicts led to supply failure. Water scarcity was also experienced in the camp areas located far from the service reservoir. Additional factors impacting service reliability included inconsistent energy supply, vandalism of cables, and wildfires around the wellhead.
During Phase 3 the piped water supply rate from the ITWU remained uniform for all customers, regardless of their economic status. Throughout 2020 the tariff was set at ETB 16.91 per m3 ($ 0.56 2022). Households without a connection in Thurpham town paid ETB 1 per jerrycan, which is ETB 50 per m3 ($ 1.65 2022), while in Itang town, they paid ETB 2 per jerrycan, which is ETB 100 per m ($ 3.30 2022). In the camps, water supply remained free of charge at the point for refugees, with UNHCR paying the bill to ITWU based on bulk meter readings at the three camps.
In July 2021 the utility increased the tariff to ETB 22 per m3 ($ 0.60 2022), which was further revised in July 2022, to ETB 26.5 per m3 ($ 0.54 2022). In November 2023, discussions were in place to further review the tariff to cater for the high operational costs. Itang utility has been reported to be operating on losses from May 2023 due to high fuel prices. Recent solarization of the pumping stations has reduced the requirement for diesel fuel, and the utility is evaluating a plan to adjust the water tariff accordingly.
In 2022 non-revenue water was calculated by the ITWU to average 10 per cent, ranging from a low of 4 per cent in April 2022 to a high of 16 per cent in March 2022.

Costs

Phase 3 is purely system optimization and expansion. The main completed or ongoing activities include the drilling of four new boreholes; rehabilitation/replacement of three problematic boreholes; pipeline expansion; installation of a solar system at the collection chamber and booster station; installation of automatic chlorination systems; construction of new concrete reservoirs with a total capacity of 1,300 m3; construction of two workshops, three pump houses and two additional water points; and the construction and installation of one fuel tank.

The calculated capital expenditure for the permanent infrastructure was $ 5,411,109 ($ 6,668,235 2022) during Phase 1, and $ 8,686,596 ($ 10,288,978 2022) during Phase 2. The total investment cost for Phase 3, which is an ongoing investment, is estimated to be $ 15,000,000 between 2020 and 2025. The solar system as part of Phase 3 is estimated to cost $ 1,403,000. When converting these costs into $ exchange rate of 2022 for the purpose of comparison, the total investment over the three phases will be $ 31,957,213. This investment has led to the production of approximately 4,113 m3 per day and once completed, the optimized system is designed to have a production capacity of 10,000 m3 per day. The current production (4,113 m3 per day) quantity can supply 164,520 people with 25 LPD, whilst the final optimization target is for over 322,000 people with over 25 LPD. Thus, an investment of $ 225 per person has resulted in the production of 25 LPD. The investment of $ 31,957,213 has ensured the production of 4,113 m3 per day for (approx.) the next 30 years, minus operating costs. This is an investment cost of $ 0.71 per m3 of water.

In 2022, the monthly operation and maintenance (O&M) costs ranged between ETB 388,800 ($ 7,858 2022) and ETB 836,000 ($ 16,896 2022) with an average monthly cost of $ 12,377 (2022). Costed items included leak detection and maintenance (minor and major); genset servicing; electrical inspections; training of plumbers, technicians, and supervisors; purchase of genset fast-moving items and other electrical fast-moving items; safety shoes and raincoats; purchase of chemicals; and staff per diem costs.

Monthly fuel costs between 2022 and 2023 ranged between $ 15,440 in April 2022 to $ 33,961 in May 2023. During this period the average monthly cost for diesel was $ 22,168 (2022). However, the increased cost does not reflect increased pumping, but rather increases to the price of diesel as a result of decreasing subsidization by the Government of Ethiopia. The price per litre of fuel rose from ETB 30.25 ($ 0.61 2022) in April 2022 to ETB 71.08 ($ 1.44 2022) in May 2023.
The introduction of the solar system is expected to have a significant impact on costs related to powering the water supply system. UNICEF calculates a significant reduction in the grid and diesel fuel requirement; it is expected that the investment of around $ 1.4 million in the partial solarization of the power supply systems will run reduce generator power generation by 41 per cent in the long run. Over a 15-year period the solar system is predicted to generate savings of more than $20 million on capital maintenance costs (for renewing assets to maintain the initial level of service) and daily operation and routine maintenance.
In 2023 the solar system has been installed at the collection chamber (333 KW) and booster station (371 KW) and started operating in October 2023. The system provides power to five solar pumps with varying levels of 203 KW of total power. Three pumps are set up at the collection chamber and two pumps at the booster station. The system is powered by solar, grid and generators (to be used when there is cloud cover and no electricity).
Initial data for the first month of operation (October to November 2023) show immediate results in transitioning power from only grid power to combined power from both grid and solar. For the individual pumps the proportion of solar power supplied varied between 12 and 59 per cent across the first month of operation. While two of the pumps were not operational due to a pipeline issue, the three operational pumps supplied a total of 14,961 KW of solar power to the system, representing 27 per cent of the total power used. The decreasing dependence on grid and fuel is expected to have a significant positive impact on the operational cost requirements for running the system.

According to the ITWU annual income and expense statement for 2022, the full utility operating expenses amounted to ETB 25,866,573 ($ 522,763 2022). This is inclusive of salaries, travel, transport, operation and maintenance, fuel, bank charges, office supplies and other costs.

If the lifespan of the system is 30 years and the capital investment in infrastructure is around $ 31,957,213, the CapEx can be calculated at $ 1,065,240 per year. The investment cost is $ 0.71 per m3.

Together, the annualized CapEx ($ 1,065,240) and operating costs ($ 522,763) can be calculated at approximately $ 1,588,003. With current annual water production in Phase 3 of approximately 4,113 m3 per day, the cost is $ 1.03 per m3.

With the recent solarization and the corresponding reduction in diesel fuel required to power the system (whist still producing the same daily volume), the cost of CapEx and OpEx are calculated at $ 0.93 per m3.

Phase 3 plans to deliver 10,000 m3 per day for 322,000 people. With the projected production capacity of 10,000 m3 per day the cost (inclusive of CapEx and OpEx) could be as low as $ 0.44 per m3.

In relation to the revenue, it is important to note that in 2022 the average ITWU monthly revenue was ETB 2,525,279 ($ 51,036 2022). Of this, 95 per cent ($ 50,520 2022) came from a single client: UNHCR.

BY THE END OF PHASE 3

- Number of beneficiaries: In April 2023 234,835 people in three camps (Kule 51,968, Nguenyiel 111,409, and Tierkidi 71,458 people) and 26,340 people in the host community.
- Water transportation: in 2023 a mix of diesel, grid, and solar power.
- Further investments in sources to increase production and a diversification of energy sources towards electrical grid power for pumping.
- Estimated water supplied to camps in the range 10.2-20 LPD.
- Cumulative investment costs totallng almost $ 32 million, with an estimated cost per m3 of $ 0.93 (and eventually as low as $ 0.44 per m3).

BOX 5

Discussion

Increasing service levels through Phases 1-3

The water supply system for the camps and host community in Itang and Thurpham towns has passed through three main phases of development. In Phase 1 (2014-2016), water was initially supplied through surface water treatment, then four shallow boreholes and water trucking operations. In Phase 2 (2016-2020), the system expanded to seven borehole sources, equipped with high discharge pumps and generators, storing up to 7.75 million litres and supplying 3.5 million litres of water daily. Water trucking continued for the newly established Nguenyiel refugee camp while the piped system was being developed. Phase 3 (2020-present) saw the system having eight functional boreholes powered by grid and 23 generators, along with transmission and distribution pipes, collection, booster and service reservoirs, and pump houses. System optimization through installation of solar power system, construction of additional boreholes, pipelines, and reservoirs.

In Phase 1, the functionality was low, due to regular issues with generators requiring continuous maintenance. By the end of Phase 2, 192,561 people in the three camps received 77 per cent of the water from the system, while the host community received 23 per cent through kiosks and institutional connections, but generator-related problems resulted in a 43 per cent reduction in water production capacity. At the beginning of Phase 3, the system faced challenges such as old and non-functioning generators, insufficient water sources, and a shortage of spare parts and tools. Water supply interruptions increased due to breakdowns of generators, pumps, and pipelines. Significant efforts to address these issues were made, which resulted in resolution of by the later stages of Phase 3. The data shows a trend of functionality improvements over time, with an average of eight out of 10 boreholes functional by 2020.

The estimated average quantity of water supplied from the scheme varied across the different phases, but challenges with bulk meters made calculations less reliable. In Phase 1, the four boreholes collectively produced between 1,555 m3 to 1,944 m3 per day. In Phase 2, production ranged between 2,200 to 3,590 m3 per day. Despite production challenges and difficulties in calculations, the available data demonstrates a significant increase in water production. By Phase 3 the system was producing 4,113 m3 per day on average.

The average quantity of water per person varied across the different phases. In Phase 1, the available water ranged from 9.5 to 15.3 LPD in Kule camp, based on recorded population and water supply data. In Phase 2, Kule and Tierkidi refugee camps received 14 to 15 LPD according to the 2017 Itang utility business plan, with an increase in water consumption observed. The Joint Assessment Report (2019) estimated that the system supplied between 15 to 17 LPD to the refugee camps and host communities. However, there were discrepancies and imbalances in the water supply, with some camps receiving less than the target level. By December 2020, the water system mostly delivered services meeting the UNHCR minimum standards of 15 LPD.
The estimated time and distance travelled for water collection varied across different phases. In Phase 1, households in Itang mostly obtained drinking water from hand dug wells within 500 metres, with the majority spending less than 30 minutes for collection. However, in Thurpham, 98 per cent of respondent households spent more than an hour fetching water, and no residents lived within 2.5 kilometres of a water source. In Phase 2, during a UNICEF affordability study, refugees accessed water from public water points located within the camps at reasonable walking distances of less than 250 metres from their dwellings. By Phase 3, there were increasing connections to households and other establishments, reducing the distance travelled for water collection. In an affordability study conducted in 2021, 49 per cent of respondents considered the distance from their household to be 'not far'. The data shows a clear trend of decreasing collection time in the camps and host communities.

The estimate for water quality varied across the different phases. In Phase 1, a study found a substantial lack of safe water in 2014. In 2020, a water chemistry analysis showed that overall water quality in the area was good, although some wells had elevated levels of iron and molybdenum, exceeding WHO limits. The study concluded that water quality was generally very good. There were concerns raised in the TWG minutes and the Climate Resilient Water Safety Plan regarding the potential risk of contamination in different locations, including well field and reservoir contamination, pipe breaks, poor wellhead completion, and cross-contamination in collection chamber reservoirs. The water quality situation improved in Phase 2, but challenges remained in Itang town and the camps. By 2021, the affordability study found 73 per cent of respondents described the water quality as good, and there is general agreement on the significant improvements in water quality across the documentation.

The reliability of water services has been a significant issue in various areas. The ITWU Climate Resilient Water Safety Plan identified problems such as intermittent water supply, water scarcity, and system failures in different locations. In Thurpham, intermittent supply was caused by external pressure, competing water uses, illegal connections, and operational limitations. The Thurpham booster station experienced supply interruptions due to cavitation and the absence of backup systems. Water scarcity and intermittent supply were observed in Tierkidi and Nguenyiel refugee camps due to management and operational challenges. Kule camp faced intermittent supply and system failures due to the absence of backup pumps and pipes being cut during conflicts between different communities belonging to refugee and host populations. The reliability of water services was also affected by generator breakdowns, pipe bursts, and inconsistent energy supply. Efforts were made to address these issues, such as setting up an emergency surface water treatment plant in Itang for water trucking. Overall, the reliability of water service improved over time, but challenges remained. The discussion on the improvement of water service levels from 2014 to 2022 reveals a mixed picture of progress and challenges. Efforts to enhance water source accessibility, improve water quality, promote the use of safely managed sources, and increase service reliability have yielded positive outcomes, though there is room for further improvement. The findings underscore the importance of sustained investments in infrastructure, maintenance, monitoring, and capacity building initiatives. In conclusion, water services delivered to host communities and camps improved significantly between 2014-2022. Phase 1 highlighted the urgent need for interventions to improve water infrastructure, enhance water quality management, and ensure more reliable service delivery. Phase 2 demonstrated the positive impact of targeted interventions and collaborative efforts in upgrading water service levels. Phase 3 showcased the sustained commitment to enhancing water services and the positive outcomes achieved through comprehensive interventions.

Table 1: Summary of infrastructure and service delivery indicators across phases, Itang, Ethiopia

	Phase 1	Phase 2	Phase 3	Sources	Reliability of data
Population served	Approximately 120,000 in camps and 18,354 in host community	In March 2020, there were 192,561 people in the three camps and approximately 22,000 in host community	In April 2023, there were 234,835 people in the three camps and 26,340 in host community	Multiple cross-referenced sources	High
Description	Initial water trucking to camps, handpumps and untreated surface water NGO led operation, beginning of piped network	Piped network, gensets and grid, NGO operation transitioned to utility model, billing to host community & UNHCR, tap stands, kiosks, yard connections, household connections	Increasing production and service quality and accessibility in camps and host community	Multiple cross-referenced sources	High
Water sources in service for the camps and host community	Submersible pumps Surface pumps, 4-7 boreholes	7-10 boreholes, submersible and surface pumps	Plan to increase to 14 boreholes, submersible and surface pumps	Multiple cross-referenced sources	High
Functionality of water supply	Low functionality	Improving functionality (4-6/7 boreholes functional)	Further improved functionality (8/10 boreholes functional)	UNICEF 2020, Joint assessment report 2019, TWG minutes, ITWU Climate Resilient Water Safety Plan	High
Estimated average quantity of water produced	778-1,900 m3	2,000-3,590 m3	2,200->4,113 m3	Join Assessment Report (2019), dataset recordings in Excel, IRC datasets, ITWU documents, TWG meeting minutes, SAWA (2020)	Increasing reliability through phases
Energy sources	100% water trucking	100% pumped with diesel	a mix of diesel, grid, and solar power	Multiple cross-referenced sources	High

Average quantity of water consumed	9.5-15.3 LPD in camps	11-17 LPD in camps	10.2-20 LPD in camps	IRC report (2017), Joint assessment report (2019), UNICEF (2019), IRC and Utility datasets, TWG minutes, UNHCR factsheets	Increasing reliability through phases
Estimated time and distance travelled for water collection	500 m to 5 km	<250 m in camps	'not far' from household	Affordability Study (2016, 2018 and 2021)	Medium
Estimate for water quality	Drastic lack of safe water	Unsafe, but improving	Greatly improved	Climate Resilient Water Safety Plan (2020), Hydrological Study, 2020, TWG minutes, ITWU reporting	Increasing reliability through phases
Number of people using safely managed sources	Mostly hand dug wells in host community and trucking in camps	Movement towards piped supply	Increasing number of household connections in host community	Multiple cross-referenced sources	High
Reliability of service	Poor	Improving	Greatly improved	Multiple cross-referenced sources	Medium
Affordability	Low affordability especially in Thurpham	Improving affordability, highly dependent on household connection	Improving affordability, highly dependent on household connection	Multiple cross-referenced sources	High
Cost estimate per m3	$11.38 per m3	$1.61 per m3	$0.93 per m3	Calculated from multiple cross-referenced sources	High

Discussion

Decreasing costs for delivering services through Phases 1-3

The Itang water supply system underwent several phases of investment and development from 2014 to the present. During Phase 1, the infrastructure investment (assumed at 50 per cent of the total incurred) and running costs for the water trucking operation amounted to $ 8,306,048 (USD 2022), resulting in a daily average supply of 1,000 m3 at a cost of $ 11.38 per m3. In Phase 2, the cumulative investment increased to $ 16,957,213 to provide daily production of 3,590 m3 at a cost of $ 1.61 per m3. In Phase 3, the investment is expected to reach $ 31,957,213, providing a daily average supply of 4,113 m3 of water at a cost of $ 0.93 per m3.

With these significant investments, there were ongoing efforts to improve sustainability, including resource mobilization for backup equipment like pumps and generators, as well as exploring alternative power options like electric grid and solar systems. In 2024 the annual utility operating expenses have decreased from $ 522,763 earlier in Phase 3, to $ 333,955 in 2024, with the introduction of the solar system at the pumping stations and the corresponding reduction in diesel fuel consumption. With an assumed 30-year life cycle, the system is producing water at a cost of $ 0.93 per m3. Furthermore, if the costs of Phase 1 are assumed to be spent on temporary solutions and can be considered exhausted capital expenditure, the combined costs of Phase 2-3 for capital and operational expenditures result in a cost of $ 0.86 per m3.

The affordability of water supply varied across different phases of the project. During Phase 1, an affordability study revealed that households in Thurpham paid ETB 8-10 per jerrycan of water, while Itang residents paid ETB 0.5-4 per jerrycan. Over 95 per cent of Thurpham residents found the water to be unaffordable, compared to less than 20 per cent in Itang. In Phase 2, the review indicated that unconnected households, particularly the poor families who relied on individual vendors, faced higher costs of ETB 50-100 per m3. In Phase 3, a study showed that 78 per cent of respondents in Itang paid for water, with most households paying around ETB 50 for daily water transportation.

The tariff for piped water supply was set at ETB 11 per m3 in Phase 2, which increased to ETB 22 per m3 in July 2021 and further to ETB 26.5 per m3 in July 2022. To account for increasing fuel costs, by early 2024 the tariff increased to ETB 42. Overall, the affordability improved over the phases, particularly for households connected to the water supply system. However, the cost remained a challenge for unconnected households who relied on alternative sources and vendors.

We can conclude that the expansion of the system provides good value for the investment. Increasing production can be done at a comparatively lower cost once the distribution infrastructure is developed. The data presented below shows the system can scale effectively and that system expansion results in increasing water production and decreasing production costs.

Conflict sensitive and peace-building approaches

During the development and transition of the Itang water system towards a utility-managed model, conflict-sensitive and peace-building strategies were intentionally incorporated. The Itang Woreda is susceptible to conflict due to the significant influx of South Sudanese refugees, primarily from the Nuer tribe, settling in an area inhabited by various ethnic groups such as the Anuak and immigrants from Ethiopia's "highlands". The Itang water system caters to the refugee population in three camps located at higher altitudes, while the water is sourced from the Baro river where the Anuak host community lives; any interruption of water delivery to the camps can ignite active conflict between the refugee and host communities. Additionally, the Gambella region also has experienced frequently over the past years a security issues which results in access restrictions due to conflict in bordering areas with the Oromia region.

To mitigate potential conflict and develop a more sustainable integrated water system that can contribute to strengthening the peace, the programme has used several entry points. Extensive consultations were held during the feasibility and system design phases among different beneficiary communities (including representatives from various refugee camps and host communities) and key stakeholders (such as local, woreda, and regional authorities, utility, implementing parties, UNHCR, UNICEF). All these parties endorsed the final design options through consensus.

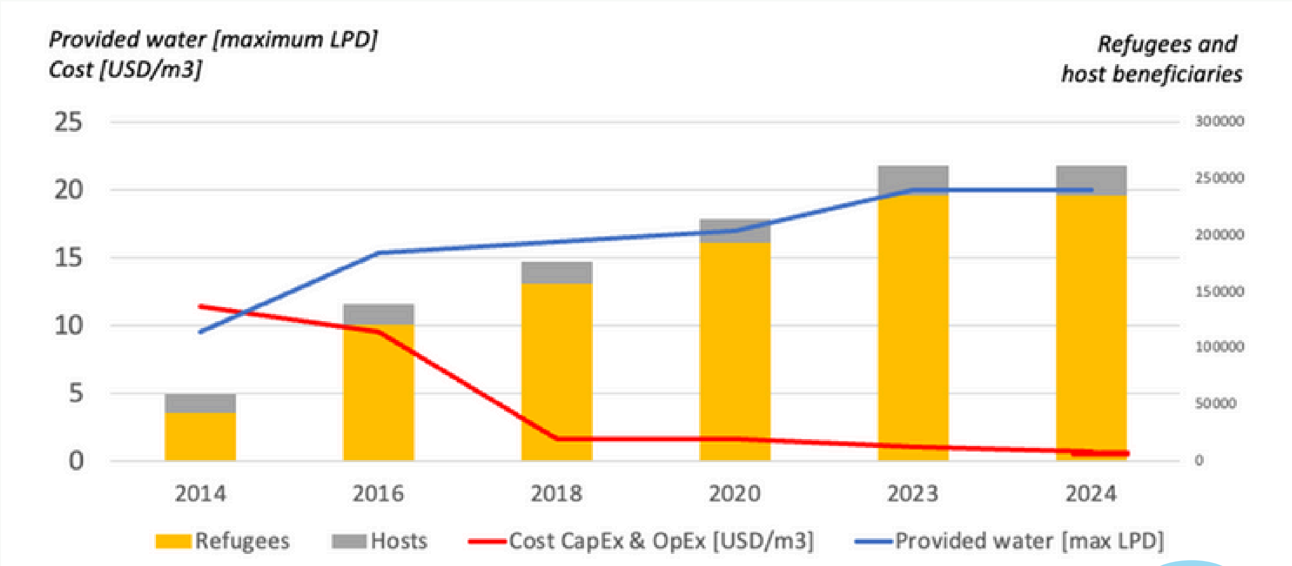
Conflict resolution mechanisms were established as part of the environmental and social management framework to address disputes or conflicts that arose during implementation. A technical working group, comprising representatives from all key stakeholders, was formed to guide the program implementation, ensure "business continuity" by developing a business continuity plan, and facilitate adaptive management processes between emergency and development (for instance, to activate emergency water trucking during water system failure). This group provided a platform for regular dialogues between both hosting and refugee communities and other stakeholders, which is crucial for conflict resolution.

Conflict resolution mechanisms have also been integrated into the utility operation. Examples include the utility's involvement in establishing water point management systems, ensuring equitable service delivery among different communities, having staff representation from different communities, conducting regular perception and affordability studies, and establishing a functional utility management board with relevant representation of key stakeholders.

These programme approaches have contributed to building a sustainable water system while mitigating conflict related risks (related to both impact by conflict, as well as due to conflict dynamics on the ground) during the system development.

Table 2: Calculated water production costs through the service delivery phases

	Average production m3 per day	Total CapEx		Assumed lifespan	CapEx cost per year (USD 2022)	OpEx cost per year	CapEx and OpEx per year	OpEx and CapEx cost per m3 (USD 2022)
Phase 1 (water trucking)	1,000	3,452,030 (50% assumption)		2	1,726,015	2,427,009	4,153,024	11.38
Phase 2	3,590	16,957,213		20	847,861	1,259,436	1,847,861	1.61
Phase 3	4,113	30,557,213		30	1,018,574	522,763	1,588,003	1.03
Phase 3 (with solar)	4,113	31,957,213		30	1,065,240	333,955	1,399,196	0.93



Source: Authors

Overview of key results of water service delivery in Itang over time shifting from water trucking to a fully-fledged utility managed water system: number of refugees and hosts, cost evolution in $US per cube meter (life cycle cost calculation based on both capital investments or "CapEx" and the costs related to operation and maintenance or "OpEx", and maximum water in liter per person (LPD) per day.

Water supply in Rwamwanja Phase 1 2012-2018

Infrastructure

Since 2012 Uganda has faced a large influx of refugees from the Democratic Republic of Congo (DRC). Rwamwanja settlement, which had been closed since 1995, was re-opened by the Ugandan Office of the Prime Minister (OPM) on 17 April 2012 to accommodate new refugee arrivals from the DRC. Between 2012 and 2014 the settlement had a total of 55 boreholes, 51 fitted with handpumps and four motorized with a pipeline distribution to 11 tap stand locations (40 water taps) serving 53,361 refugees.
Between 2015 and 2018 the number of handpumps increased to 79 and the number of boreholes motorized with a pipe network increased to six. Additionally, eight protected springs had also been constructed. Between 2015 and 2019, 21 handpumps, two motorized systems and eight protected springs had been added to the distribution network.
Below is a summary of the components of the six motorized systems constructed in Phase 1 (2012-2018).

1. The Basecamp System includes borehole source DWD 38946, a hydroelectric power source, four 10 m3 PE-tanks, three public standposts in the Refugee Settlement, one prepaid water meter (not yet functional) and an erosion chlorinator.
2. The Kaihora Water System includes a borehole source, power source of six solar panels, a standby diesel generator power source (not in use), one 10m3 PE-tank, three public standposts in the Refugee Settlement, one prepaid water meter (not yet functional), and an erosion chlorinator.
3. Rwamwanja Solar System comprises a borehole source, solar power source (14 panels), three 10m3 PE-tanks, and an erosion chlorinator.
4. The Kyempango system includes a borehole source, solar power source (7 panels), a standby diesel generator power source (not in use), one 10m3 PE-tank, three public standposts in the Refugee Settlement, and a Dosatron chlorinator.
5. The Kyempango B system comprises a borehole source, solar power source (14 panels), a standby diesel generator power source (not in use), two 10m3 PE-tanks, two public standposts in the Refugee Settlement, a Dosatron chlorinator.
6. The Kyempango C system includes a borehole source, solar power source (18 solar panels), a standby diesel generator power source (not in use), two 10m3 PE-tanks, four public standposts in the Refugee Settlement, one prepaid water meter (not yet functional), and a Dosatron chlorinator.

During Phase 1, all the water supply systems were managed by community volunteers under the Community Based Management System (CBMS). Water and Sanitation committees were selected to manage the handpumps and public standposts. The committees worked alongside handpump mechanics that had been trained by UNHCR to conduct minor maintenance that includes the replacement of taps, nuts and valves above ground (handpumps). Lutheran World Federation (LWF) provided technical support to the committees and was responsible for the rehabilitation of the handpumps.

Services

Water coverage at the end of 2013 was 13 LPD when calculating total production over total population. The distance to the nearest water points ranged between a few metres to three kilometres and the time spent at water points varied between five minutes to one hour. The quality of the water provided was reported to be good.

In March 2014, Rwamwanja settlement had a population of 53,361 refugees and the system was supplying 679 m3 of water per day. The number of refugees increased to 64,256 by June 2018, at which time the system supplied 900 m3 per day. A Knowledge Attitude and Practice survey conducted in 2017 by LWF showed that handpumps were the main source of water supply for 80 per cent of the 1,613 respondents. Eighty-four per cent of the respondents were able to access a water point within a walking distance of 500 metres and the average time taken to collect water was 30 minutes. The survey further revealed that 71 per cent of the respondents were satisfied with the quality of water. A follow-up survey conducted in 2018 revealed that the average time taken on a round trip to collect water reduced to 26 minutes.

Costs

The period 2012-2018 accounted for the highest level of investment at $ 1,104,820 (2022). The handpumps were the predominant water supply technology and accounted for 64 per cent of the investment costs, and motorized systems 19 per cent. The source of finance for the motorized system were UNICEF and UNHCR while the handpumps were financed by several actors including the LWF, the International Organization for Migration, UNHCR, UNICEF, and the Bureau of Population Refugees and Migration. During Phase 1, the investment of $ 1,104,820 (2022) resulted in an estimated daily average supply of 900 m3. This quantity can supply 25 LPD to 36,000 people.

Water Supply Rwamwanja Phase 2: 2019-present

In Phase 2 (2019-present), one additional system was constructed with two pumping stations in addition to seven handpumps and seven protected springs. By September 2022, the settlement had seven motorized boreholes linked to a piped network with a total of 653 active connections, which included domestic connections, public standposts (PSPs), and institutional commercial connections. Capital investment included a submersible pump, generator, transmission pipeline for Katalyeba Mains extension, and 182 solar panels for reinforcing power supply at the pumping stations. The settlement also had 101 point water sources (handpumps and protected springs). Components of the motorized system include the following.

1. *The Baraka station with a borehole source, 275 Wp solar panels and a 30 kVA standby diesel generator.*
2. *The Waijagahe station with a borehole source and 275 Wp solar panels.*

The Baraka and Waijagahe systems are connected to the Nkoma Reserve steel tank (108 m3) that serves the host community of Nkoma Katalyeba Town Council. The total number of connections for the Nkoma-Katalyeba National Water and Sewerage Corporation (NWSC) branch is 466 connections.

NWSC assumed responsibility for water supply services to the settlement and manages all operation and maintenance activities of the motorized schemes. This was in line with the Water and Environment Sector Refugee Response Plan (WERRP) launched in 2020 to transition all services to national systems such as district local governments, catchment committees, and water supply utilities.

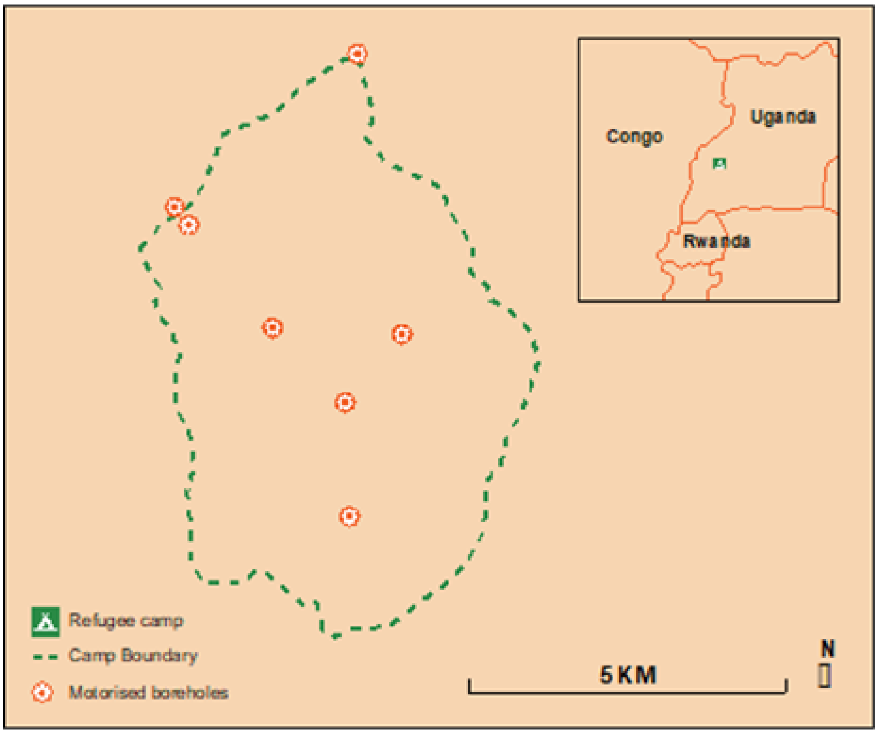
Status of piped water system at start of Phase 2

Before the handover of management of the piped water system to NWSC, a Joint Assessment of the Infrastructure was done in 2019 to establish the performance status of each of the motorized systems in preparation for takeover by NWSC. The assessment team comprised NWSC, UNHCR, Kamwenge District Local Government, LWF (the outgoing OP) and Oxfam (as incoming OP). The table below shows the status of the systems.

Following the handover of the systems in February 2020, NWSC assigned the branch office in Nkoma Katalyeba the responsibility for the provision of services and management of the assets in the settlement. About 10 staff are assigned to the settlement. They include plumbers, a commercial assistant, an engineer, and an accountant (based at the Branch office).

The management strategy adopted by NWSC includes the prioritization of health facilities, the use of the existing and well-established Water User Committees in the management of Public Standposts (PSPs), the identification of high priority areas such as reception areas and flexibility in the allocation of resources to ensure adequate services during periods of high demand such as the weekends.

In Rwamwanja, motorized boreholes are located across the camp area



Source: Authors

The Rwamwanja Refugee Settlement Water and Sanitation Board was established to manage all the water point sources – boreholes fitted with handpumps, shallow wells and protected springs – with the support of water and sanitation committees responsible for the day-to-day operation of water points in the 13 zones of the settlement. The committees oversee a water point for about 50 households, with each household expected to contribute UGX 1,000 per month ($ 0.30 in 2022) of which 20 per cent should be remitted to the Water Board. Handpump mechanics support the committees in repairing water points in case of breakdown. Oxfam provides technical support to the WSCs and the Board to perform their roles. However, the Oxfam data on key performance indicators as of September 2022 show that payment for water remains a challenge in the refugee settlement. None of the committees collected water user fees at the water points between June and September 2022, and thus, the operation and maintenance of point water sources are subsidized by Oxfam.

Services

In 2019, LWF rehabilitated 70 handpumps in the settlement. The 2019 Knowledge Attitude and Practice (KAP) survey showed that the rehabilitation contributed significantly to improved accessibility and this reduced the time taken by users to collect water. The survey results show that 86 per cent of the 380 respondents took 4-12 minutes on a round trip.

Table 3: Status of the water systems at the time of transfer to NWSC

Water System	Status of the System at the Time of Transfer
Kaihora Water System	The generator was in poor condition. The electrical installations were in poor condition and needed rewiring. Disinfection was done using online chlorine dosing. Both the borehole and the chlorine dosing system were in good condition. 1No. 10m3 HDPE tank serves as storage. All bulk meters were defective.
Kyempango A	The generator was in poor condition. The electrical installations were in poor condition and needed rewiring. Disinfection was done using online chlorine dosing. Both the borehole and the chlorine dosing system were in good condition. 1No. 10m3 HDPE tank serves as storage.
Kyempango B	The generator was in poor condition. The electrical installations were in poor condition. Disinfection was done using online chlorine dosing. Both the borehole and the chlorine dosing system were in good condition. 2No. 10m3 HDPE tanks serve as storage. The bulk meters at the tank were defective.
Kyempango C	Disinfection was done using online chlorine dosing. Both the borehole and the chlorine dosing system were in good condition. 2No. 10m3 HDPE tanks serve as storage: 1No.10m3 HDPE tank was functional and 1No. 10m3 HDPE tank was leaking.
Base Camp	Disinfection was done using online chlorine dosing. Both the borehole and the chlorine dosing system were in good condition. 2No. 10m3 HDPE tanks serve as storage: 1No. 10m3 HDPE tank was functional and 1No. 10m3 HDPE tank was leaking.
Rwamwanja SS	Disinfection was done using online chlorine dosing. Both the borehole and the chlorine dosing system were in good condition. There was no backup power source and no standby pump. A 10 m3 HDPE tank serves as storage. All components were in good working condition.

Between 2021 and 2022, the distribution network was expanded by 50 km. By 2022, the water supply network had a total of 65 functional PSPs and 140 private connections (73 domestic, 67 commercial/institutional). This contributed to a reduction in population per PSP and reduced the queues at the PSPs. Storage capacity within the settlement also increased by 42 per cent from 120 m3 to 208 m3. However, this storage capacity is still not adequate to meet the water supply standards (the standards require that a water network is able to store 30 per cent to 50 per cent of the daily demand).

WASH gap analysis data for Rwamwanja shows that the average quantity of water produced per day by the system by December 2022 was 1,130 m3 per day (an increase of 26 per cent since June 2018). As a result, the quantity of water produced in the refugee settlement increased to 12.8 litres per person per day. However, point water sources (handpumps) account for 86 per cent of the water produced in the settlement. The Economic Assessment conducted on water systems transfer in 2022 further showed that despite the significant increase in the volume of water produced in Phase 2, the motorized systems were operating way below their capacity. The study estimated the total daily production of the system at 1,160 m3 per day whereas the water produced as of December 2022 was 218 m3 per day.

As of September 2022, 95 per cent of the handpumps and six of the seven motorized boreholes connected to the pipe network were fully functional. The motorized borehole located at Rwamwanja Senior Secondary school was partially functional. The motorized system provided an average of five hours of water supply for both the settlement and host community.

The period 2019-2022 registered a rapid increase in accessibility to safe water. The total number of connections to the pipe network in the settlement and host community increased by 40 per cent between 2021 and 2022 (from 466 to 652). The number of standposts in the settlement also increased by 44 per cent while those outside the settlement increased by 37 per cent during the same period. However, due to rising fuel prices that the utility was not able to operate the diesel generators and depended solely on the solar systems. As a result, the water supply decreased, especially during the rainy seasons when the efficiency of the solar systems is low. In addition, the solar systems do not have batteries for storage, and so cannot store energy for use during periods of low solar intensity. The impact is that water supply availability and reliability in the settlement has reduced (Economic Assessment report 2022).

Table 4: Number of connections on the Rwamwanja Piped water system over the period 2019-2022

Year	2019	2020	2021	2022
Domestic connections within refugee settlement	-	45	72	73
Public standpipe connections	15	27	54	65
Institutional & commercial connections	53	53	37	67

Water Quality

Data collection on water quality for both the pipe network and point water sources was not consistent between 2012-2019. Consistent data became available after 2020 when NWSC took charge of managing the pipe network. NWSC data collected in November 2021 from three water systems in the settlement showed that the water supplied was of good quality and different parameters assessed were in line with the national standards for drinking water. NWSC continues to conduct frequent water quality assessments. The NWSC report on key performance indicators for 2022 showed that water quality testing was done every month for all the schemes.

Water samples from 14 water points (11 handpumps, two protected springs and the Kyambara spring) were collected in November 2021 for physiochemical analysis. The results showed that all samples had higher values of nitrite than specified in the Ugandan National Standards (max. 0.003 mg/l). The measured values for NO_2 were in the range of 0.017 to 0.092 mg/l indicating anthropogenic contamination likely from toilets and wastewater.

Point water sources account for 86 per cent of the volume of water supplied in the settlement and cost 40 per cent of the total investment. However, they provide a lower level of service due to higher levels of contamination. Despite the high risk of contamination of point water sources, there are no mechanisms for consistently monitoring the quality of water delivered and for mitigating contamination.

Pipe networks on the other hand only account for 16 per cent of the volume of water and provide a better service that meets the national drinking water standards. The management approach by the utility provides a more systematic process for monitoring water quality and ensuring that users receive a higher level of service. Point water sources account for 86 per cent of the volume of water supplied in the settlement and cost 40 per cent of the total investment. However, they provide a lower level of service due to higher levels of contamination. Despite the high risk of contamination of point water sources, there are no mechanisms for consistently monitoring the quality of water delivered and for mitigating contamination. Pipe networks on the other hand only account for 16 per cent of the volume of water and provide a better service that meets the national drinking water standards. The management approach by the utility provides a more systematic process for monitoring water quality and ensuring that users receive a higher level of service.

Costs

Investment in the motorized system accounted for 89 per cent in the period 2019-2022 while the handpumps and protected springs accounted for 11 per cent. The total investment over the period was $ 695,233 ($ 792,565 2022). NWSC invested in assets worth $ 486,654 ($ 554,877 2022) while UNHCR/UNICEF invested $ 131,579 ($ 150,025 2022) over the period to expand the distribution mains, reinforce power supply and improve storage capacity.
Capital expenditure includes: design of the system; drilling and equipping boreholes; genset house; solar panels; laying pressure mains, connection wells and master storage reservoirs; construction of elevated storage tanks' connection to master storage tanks and laying piped network in the settlement; and construction of yard tap stands.

The data on the operational costs can be calculated by adding the expenditure on operation and maintenance and that on direct support provided by the implementing partners and NWSC. The costs incurred by implementing partners were captured for 2018 to 2019 and reported in the Economic Assessment report 2022. The costs for NWSC are based on reported costs for 2021 and cost estimates for 2022 provided by NWSC staff in Kamwenge Office. The NWSC only applies to costs for maintaining the piped network system.
The annual operating cost for the implementing partners for 2018, before the Rwamwanja settlement water system, was $ 354,466 (2022) whereas the cost for NWSC in 2022 for operating the pipe network was $ 45,493 (2022). However, the estimate does not capture the full operational costs of NWSC since the information on the full cost of the support infrastructure from district, regional to national was not available. NWSC considers its operational costs, including those incurred for provision of services to Rwamwanja, to be within the norm for the global NWSC systems. It is therefore difficult to determine the OpEx clearly and accurately for Rwamwanja and its host community due to a lack of detailed OpEx data. If the annual cost of maintaining the handpumps estimated at $ 14,000 is added, the total cost of operating the water system comes to $ 59,493 (2022). This implies that the cost of operating the system will be reduced from $ 354,466 in 2018 to $ 59,493 in 2022.

Water tariffs

The two tariffs applied in the refugee settlements are the public standposts and domestic rates (household connections). Refugee and host community customers are charged the same rates. The water price at public standposts (where water is delivered from motorized systems) is UGX 1,060 per m3 ($ 0.29 2022) and for domestic connections UGX 3,516 per m3 ($ 0.96 2022). The contribution for handpumps is UGX 1,000 per month per household ($ 0.27 2022). The tariff charged for public standposts is less than the cost of producing water. Analysis of the tariff versus the operation and maintenance costs of producing one cubic meter of water shows that the tariffs are lower than the cost.

In 2021, the total amount billed, UGX 23.6 million ($ 6,458), was lower than the annual expenditure of UGX 38.15 million ($ 10,440). Similarly, the billing revenue in 2022 estimated at $ 43,577 was lower than the annual operating costs estimated at $ 46,066. Overall, the revenue generated does not meet the expenses as the tariff is lower than the unit operation and maintenance cost for each m3 sold.

The baseline study conducted by the R-WASH project shows that the majority of the households (87 per cent) that are currently not connected to a public water supply system would in future be willing to connect to such a system. Slightly more households in the host town are willing to connect and the significant majority (95 per cent) indicated that they are willing to pay for new connections. Among households that indicated that they would be willing to pay, those living in the host town are inclined to pay slightly more for water services than their counterparts in the refugee settlement.

The households that indicated that they have a water connection reported that they use on average 1,320 litres per month. This amounts to approximately 43 litres per day per household and 8 LPD. Those that use public standposts use about 77 litres per household per day, while those in the host town collect 80 litres per day on average. Applying the tariff to water consumed shows that households would pay UGX 4,635 ($ 1.3) and UGX 2,438 ($ 0.67) per month respectively which is more than three times what the households reported they would be willing to pay.

Table 5: Tariff versus the unit operation and maintenance costs per m3 sold

Category	Tariff	Unit O&M Cost per m3 sold
Public Standpost	1,060	2,022
Domestic	3,516	2,022
Institution/Government	3,558	2,022
Commercial > 1,500 m3	4,220	2,022
Commercial < 1,500 m3	3,373	2,022

Increasing Service Levels Phases 1-2

The water supply system in Rwamwanja settlement and host communities passed through two phases of development. In Phase 1 2012-2018, the settlement's water supply system included: a pipeline distribution network with six motorized boreholes, and 79 individual handpumps. The operation and maintenance of the systems was NGO led with tenets of community-based management. In Phase 2 2019-2022, the system expanded to seven motorized boreholes linked to a piped network with 653 active connections which included domestic connections, public standposts, and institutional commercial connections in the settlement and host community. Capital investment included a submersible pump, generator, transmission pipeline for Katalyeba Mains extension, 182 solar panels for reinforcing power supply at the pumping stations. The settlement also had 101 point water sources (handpumps and protected springs). The operation and maintenance of the motorized system (piped network) was taken over by the NWSC whereas those of the handpumps remained with the CBMS.

In Phase 1, the functionality of the handpumps was moderate while that of the motorized system was low. There were a number of challenges in terms of the reliability of the water supply, especially in the rainy season since the systems mainly relied on solar pumping. The electrical installations and back-up generators for three systems (Kaihora, Kyempango A and B) were in poor working condition. All the systems performed below their production capacity. In Phase 2, there was a rapid increase in accessibility with the number of connections in the settlement increasing by 200 per cent. The reliability of the water supply also increased. However, due to rising fuel prices, the utility was unable to operate the diesel generators and was dependent solely on the solar systems.
The estimated average quantity of water supplied from the scheme varied across the different phases, and challenges with bulk meters made calculations less reliable. In Phase 1, the 79 handpumps and six motorized boreholes produced 670-900 m3 per day. In Phase 2 production increased to 1,000-1,130 m3 per day. The data shows a significant increase in the volume of water produced across the phases.
The average quantity of water per person also varied across the phases. In Phase 1, the average quantity of water was between 13-14 LPD. In Phase 2, the quantity of water reduced to 12.8 LPD due to rapid 37 per cent increase in the population from 64,256 in 2017 to 88,180 in December 2022.

The estimated time and distance travelled for water collection varied across the phases. In Phase 1, households in Rwamwanja settlement collected water from handpumps and PSPs within 500 metres to 1 km with the majority spending less than 30 minutes collecting water. In Phase 2, the average distance was reduced to 200-500 m. The LWF WASH survey 2019 showed that households spent 4-12 minutes collecting water. In the first two years of this phase, the pipeline in the settlement was extended by 51 kms and LWF rehabilitated 70 handpumps. This helped improve accessibility to water.

Data collection on water quality for both the pipe network and point water sources was not consistent between 2012 and 2019. NWSC data collected in November 2021 from three water systems in the settlement showed that the water supplied was of good quality and the parameters assessed were in line with the national standards for drinking water. NWSC continues to conduct frequent water quality assessments. The NWSC report on key performance indicators for 2022 showed that water quality testing was done on a monthly basis for all the schemes. Water samples from 14 water points (11 handpumps, two protected springs, and the Kyambara spring) were collected in November 2021 for physiochemical analysis. The results showed that all the samples had higher nitrite (NO_2) values than specified in the Ugandan National Standards (max. 0.003 mg/l). The measured values for NO_2 ranged from 0.017 to 0.092 mg/l, indicating anthropogenic contamination likely from toilets and wastewater.

The utilization of safely managed drinking water sources is generally low across the phases. In Phase 1, households relied on handpumps and PSPs as their main water source. There were hardly any households with domestic connections before 2020. However, the number of domestic connections increased by 62 per cent from 45 to 73 between 2020 and 2022 (Phase 2). It can be deduced that with the expansion of the distribution network in the settlement, more households are opting for domestic connections. However, the proportion of households remains very low (at 0.3 per cent , December 2022).

Overall, there has been an improvement in service levels in Rwamwanja settlement. Efforts to increase accessibility, water quality and reliability have yielded positive results, especially in the piped water supply. Transition in water systems management from the NGO-led approach to the utility approach was instrumental in promoting professionalization and improving the effectiveness of the systems management. There is evidence that the utility contributed to the rapid expansion of the network and accessibility to better services in Phase 2. There is still room for further improvement that requires more investment in upgrading the assets. However, it is important to note that point water sources (handpumps, shallow wells) account for up to 86 per cent of the water supplied in the settlement. Water quality continues to be an issue for point sources and compromises the level of service they deliver since the water supplied is not treated. While the piped water system provides a better level of service, it only accounts for 16 per cent of the water supplied.

Table 6: Summary of Infrastructure and Service Delivery Indicators across phases, Rwamwanja, Uganda

	Phase 1	Phase 2	Sources	Reliability of data
Description	Handpumps are the predominant water supply technology. Maintenance of water systems are NGO led with strong focus on community-based management	Rapid expansion of the piped network. Transfer of operation of piped network to utility.	R-WASH Inception report	High

Water sources in service for the camps and host community	79 handpumps 6 motorized boreholes connected to piped network	1 additional motorized borehole connected to 2 pumping stations. Increased water storage, 101 point water sources (handpumps, protected springs)	Multiple cross-referenced sources	High
Functionality of water supply	Low functionality	Improved functionality of handpumps and reliability of the piped network	Water infrastructure inventory 2022; R-WASH Inception report; LWF Knowledge Attitude and Practice surveys 2017-2019	High for Phase 2 and low for Phase 1
Estimated average quantity of water produced	670-900 m3	1,000-1,130 m3	Oxfam Water Production data 2020 - 2022; R-WASH Inception report 2021; NWSC KPI Report 2022	Medium
Estimated time and distance travelled for water collection	500 m to 1 km	200-500 m	LWF KAP Surveys 2017 – 2019	Medium
Estimate for water quality	Poor water quality especially in point water sources (hand pumps, protected springs and shallow wells)	Improved water quality in piped network in line with national standards. Water quality from point sources still poor	R-WASH Inception report 2021; NWSC KPI report 2022	Low for Phase 1. Medium for Phase 2
Number of people using safely managed sources	Mostly point water sources (handpumps, protected springs and shallow wells)	Movement towards piped supply	Multiple cross-referenced sources	High
Reliability of service	Poor	Improving	Multiple cross-referenced sources	Medium
Affordability	Low affordability	Improving affordability, & increased number of household connections and well-maintained PSPs	Multiple cross-referenced sources	High

Decreasing costs through Phases 1-2

The Rwamwanja system went through several stages of investment and development. Phase 1 accounted for the highest level of investment at $ 1,104,820 (2022). The investment resulted in an estimated daily average supply of 900 m3 at a cost of $ 0.48 per m3. This quantity can supply 25 LPD for 36,000 people. If we estimate a life cycle of 20 years and use the 2022 estimate for operational expenditure but calculated for USD value in 2017, the total cost of water production was $ 1.42 per m3.

In Phase 2 the cumulative investment increased to a total of $ 1,809,722 to provide a daily production of 1,130 m3 at a cost of $ 0.29 per m3.

The annual operating cost for the implementing partners for 2018, before the Rwamwanja settlement water system, was $ 354,466 (2022) whereas the cost for NWSC in 2022 for operating the pipe network was $ 45,493 (2022). However, the estimate does not capture NWSC's full operational costs since information on the full cost of support infrastructure from District, Regional to National was not available. If the annual cost of maintaining the handpumps estimated at $ 14,000 is added, the total cost of operating the water system comes to $ 59,493 (2022). This implies that the cost of operating and maintaining the system will be reduced from $ 354,466 in 2018 (2022) to $ 59,493 in 2022 (2022).

The two tariffs applied in the refugee settlements are the public standpost and domestic rates (household connections). The tariff at public standposts is UGX 1,060 per m3 ($ 0.29 2022) for domestic connections and UGX 3,516 per m3 ($ 0.96 2022). The total billing revenues generated by NWSC in 2021 ($ 6,458) and 2022 ($ 43,577) were lower than the annual operating costs estimated at $ 46,066 (2022). Overall, the revenue generated is not adequate to meet the expenses as the tariff for PSPs in particular is lower than the unit operation and maintenance cost for each m3 sold. However, the average tariff of UGX 3,508 ($ 0.96) per m3 of water sold also shows that the Rwamwanja Area is in a position to generate a surplus on the tariff if collection efficiency is increased to close the deficit.

Overall, the transfer of management of the piped water system contributed to a reduction in the operation and maintenance costs and a rapid extension of the distribution network in the settlement. NWSC and partners invested up to $ 540,000 (2022) to improve the water supply infrastructure. The investment costs were met using subsidies from central government and from development partners such as UNHCR, Oxfam and KfW. Investment in expanding the system under the utility generates good value for investment at a comparatively low cost and guarantees the sustainability of the system as its management is embedded in mandated national institutions.

Table 7: Calculated water production costs through the service delivery phases

	Average production m3 per day	Total CapEx	Assumed lifespan	CapEx cost per year (USD 2022)	Cost per m3 (USD 2022)	OpEx cost per year	CapEx and OpEx per year	OpEx and CapEx cost per m3 (USD 2022)
Phase 1	900	1,104,820	10	157,831	0.34	354,466	512,297	1.42
Phase 2	1,130	1,809,722	30	452,431	0.15	59,493	511,924	0.29

Financing scenarios

This section identifies some possible options for financing integrated service provision to refugees and their host communities beyond the existing arrangements. These include considering innovative solutions for financing maintenance and cross-subsidy as well as cost recovery from users. The main focus of this section is on Itang, Ethiopia, but some comparisons and insights are draw from the Rwamwanja case in Uganda.

There is an assumption that services will continue to be provided in Itang through an integrated model serving refugees and host communities. This has been shown to be a cost-effective model, and there will always be potential to further reduce costs, but the critical question remains how best to finance the sustained delivery of these services while continuing to make further system improvements (such as through improvements in the energy supplies for pumping).

Currently, the bulk of financing for this model (95 per cent) is sourced from UNHCR (approximately $ 50,000 per month) which it sources from its donors. There is tremendous pressure on the UNHCR budget owing to crises and demands around the world. The remaining financing (5 per cent) is derived locally from host community clients (households and institutions). There are no direct payments for water by refugees and, unlike the situation in Uganda, there is no cross-subsidy within utility operations, nor subsidies from government budgets at either regional or national levels.

The following are potential alternative financing scenarios. These options could also be combined.

1. Increased financing from refugees as paying consumers and/or increased levels of cost recovery through tariffs paid by institutions and households.

2. Cross-subsidy to cover costs in areas with large refugee populations through the amalgamation of utilities to cover wider areas with a larger and more diverse customer base and greater economies of scale.

3. Subsidy from sustained regional and national budgets.

4. Financing from alternative external funding streams routed through a dedicated fund or financing facility for the subsidy of water supply operations in locations with long-term refugee populations.

Increased direct cost recovery from customers

There is potential to increase local revenues through the collection of payments for water from refugees, which may perhaps eventually cover half or more of the operating costs. This would be facilitated if refugees were to receive more direct financial support or have better income opportunities. However, the opportunities are more limited in Gambella than in some other contexts. In the Somali region of Ethiopia, a Memorandum of Understanding (MoU) between the Ministry of Labour, RRS and the Somali regional government has been agreed to facilitate work permits for refugees and some have already been issued. There is also potential for the utility to collect more revenue if it were able to extend household connections and increase tariffs to host community consumers. This would potentially still be cheaper for host community consumers compared to the current prices paid at kiosks.

Cross-subsidy through economies of scale in utility operations

In Uganda, an organization of the scale of the National Water and Sewerage Corporation (NWSC) has the potential to cross-subsidize operations in areas where the revenue base is weak (like rural and disadvantaged areas) through the services and revenue generated in other places, particularly in large urban areas and locations with well developed economies. This approach has a long tradition and has underpinned the development of services in high-income countries. However, in the Ethiopian context there is not currently a trend towards the amalgamation of utilities so while this may potentially be part of the future solution, for now that is a long way away. In Gambella especially, the host community is relatively small and other utilities are weak. This is also the case across Ethiopia where, with the exception of Addis Ababa, most utilities are small and almost none of them are currently able to recover costs. There is thus little scope for cross-subsidy.

Subsidy within sustained regional and national budgets

There is a case to be made for subsidies through government budgets, tapping support from regional or more likely, national level budgets. Sustainable water services in these locations can underpin the development of local economies and protect the investments made by external partners in capital infrastructure. There are high levels of subsidy within many water service providers, but these subsidies are typically not well targeted towards poorer and marginalized communities.

Dedicated fund or financing facility tapping alternative external funding streams

Under this scenario finance might continue to be sourced from external partners, but not from the same funding streams allocated to emergencies. There is a strong case for alternative funding in situations where refugee populations stay for years and decades, well beyond the intended emergency support, in contexts where neither national utilities (like in Uganda) or governments are willing or able to subsidize utility operations to service refugees and their host communities. This might be a multi-national or regional fund hosted by existing institutions, with a specific mandate to subsidize service delivery for the medium term in locations where utilities cannot be expected to rapidly make the transition towards locally sustained financing. This is particularly the case where host communities are relatively small, utilities are small and government budgets for subsidies are more limited. There is also a strong case to be made to tap into climate related finance, with refugees having been displaced at least in part due to climate change, persistent drought as well as conflict, and regional funds seeking to support local development and minimize international migration. Funds require a strong institutional environment to be successful, and there are good examples such as the municipal revolving funds in Eastern Europe.

RECOMMENDATIONS

The management of refugee camps, particularly in regions with protracted displacement, poses complex challenges. Among these challenges, the sustainability of essential services, such as utilities, is of critical concern. In areas like the Gambella Region of Ethiopia, where a large population of refugees resides, the delivery of services can be both technically difficult and financially challenging to sustain. Compounding these challenges is the presence of a significantly larger refugee population than the host community in some areas.
To address this issue, a comprehensive transition plan is needed. It must balance the immediate needs of refugees with the imperative of long-term financial sustainability. This plan, composed of interlinked and overlapping implementation phases, is designed to ensure that refugees can continue to access vital utility services without putting an unsustainable burden on humanitarian organizations.

We outline a series of essential implementation recommendations that encompass technical solutions, financial assessments, pricing structures, gradual transitions, targeted assistance, income generation, community involvement, monitoring, and advocacy for external funding. Each of these recommendations represents a critical facet of managing the transition effectively. Through planning, data collection, community engagement, and advocacy, we aim to guide the transition process toward a sustainable and equitable outcome. The welfare of refugees remains at the core of our efforts, as we work to strike the delicate balance between immediate support and long-term self-reliance.

01 Technical Solutions

- Detailed Assessment: Conduct a thorough assessment of potential alternative energy sources, including solar, wind, or biomass energy. Evaluate their feasibility, costs, and environmental impact.
- Pilot Programmes: Implement small-scale pilot programmes to test alternative energy solutions and measure their effectiveness in reducing utility costs.
- Infrastructure Development: Plan and budget for the necessary infrastructure improvements or installations to integrate alternative energy sources.
- Design to infrastructure and the management system for integrated water service provision with possibility of in camp distribution at kiosk, yard or household level where relevant.

02 Assess Refugee Economic Capacity

- Survey and Data Collection: Design a survey or data collection process to assess the economic capacity of refugees. Include questions on income sources, employment opportunities, and access to financial services.
- Data Analysis: Analyse the collected data to identify trends and patterns within the refugee population.
- Targeted Interventions: Develop specific interventions based on the economic capacity assessment, such as vocational training or job placement programmes.

03 Subsidized Pricing Structure

- Cost Analysis: Conduct a detailed cost analysis of utility services, factoring in current expenses and future projections.
- Subsidy Calculation: Determine the level of subsidy required to make services affordable for refugees while ensuring sustainability.
- Pricing Structure Design: Develop a clear and transparent pricing structure that reflects the subsidy and gradually transitions refugees to cost sharing.

04 Targeted Assistance

- Identification of Vulnerable Groups: Work with community leaders and organizations to identify and verify vulnerable households or individuals.
- Assistance Programmes: Design and implement targeted assistance programmes, such as direct cash transfers or in-kind support, tailored to the needs of vulnerable groups.

05 Income Generation Programmes

- Programme Development: Create detailed programme plans for income generation initiatives, specifying the skills training, resources, and support required.
- Partnerships: Explore partnerships with NGOs, local businesses, and vocational training centres to implement these programmes effectively.

06 Community Involvement

- Community Meetings: Organize regular community meetings to engage refugees in discussions about the transition and gather input.
- Community Leaders: Collaborate with community leaders to facilitate communication, cooperation, and information dissemination.

07 Advocacy for External Funding

- Advocacy Strategy: Develop a comprehensive advocacy strategy that includes targeted outreach to international donors, and relevant stakeholders including within UNICEF and UNHCR.
- Messaging and Outreach: Craft compelling messages highlighting the importance of continued external funding and its impact on vulnerable populations.

Recommendation 1: Technical Solutions

Investigate the feasibility of alternative and renewable energy sources that could reduce the overall utility costs for both UNHCR and refugees in the long term.

Table 8: Technical solutions

Activity	Implementation steps
Detailed Assessment	Identify potential alternative energy sources that are suitable for the region. This may include solar power, wind energy, biomass, etc. Conduct a comprehensive feasibility study for each energy source. It should include technical feasibility, environmental impact assessments, and cost-effectiveness analyses. Assess the existing infrastructure and determine what modifications or additions are needed to integrate alternative energy sources into the utility grid.
Pilot Programmes	Start with small-scale pilot projects in specific areas of the camp. These pilots can help test the feasibility of alternative energy solutions and identify potential challenges. Collect data during the pilot phase to measure the performance of alternative energy sources, such as energy generation, reliability, and cost savings. Gather feedback from both refugees and technical experts involved in the pilot programmes. Use this feedback to make necessary improvements and adjustments.
Infrastructure Development	Establish a budget for the implementation of alternative energy infrastructure. It should include costs of equipment, installation, and ongoing maintenance. Procure the necessary equipment and materials following transparent and competitive procurement processes. Oversee the installation of alternative energy systems and establish a maintenance plan to ensure their long-term reliability. Design to infrastructure for integrated water service provision with possibility of in camp distribution at kiosk, yard or household level where relevant.
Energy Management	Implement energy-efficient technologies and practices within the camps to maximize the benefits of alternative energy sources. This can include energy-efficient appliances and lighting. Consider implementing a smart grid system that allows for efficient energy distribution and monitoring of energy consumption.
Community Engagement	Conduct awareness campaigns to inform refugees and host communities about the transition to alternative energy sources. Explain the benefits, including cost savings and reduced environmental impact. Provide training to utility, host community and camp staff on the use and maintenance of alternative energy systems, ensuring they can take full advantage of these resources.

Environmental Considerations	Develop strategies to minimize the environmental impact of alternative energy installations. This may involve habitat protection, waste management and sustainable land use planning. Ensure that all alternative energy projects comply with local and international environmental regulations.
Financing and Sustainability	Explore financing options for sustaining alternative energy systems in the long run. This could involve public-private partnerships, grants, or revenue generation models. Consider mechanisms for cost recovery, such as selling excess energy to neighbouring communities or businesses.
Monitoring and Evaluation	Set up monitoring systems to continuously track the performance of alternative energy sources. Measure energy production, usage, and any cost savings achieved. Establish feedback mechanisms to collect input from refugees and adjust energy management strategies accordingly.

Recommendation 2: Assess Refugee Economic Capacity

Conduct a thorough assessment of the economic capacity of the refugee population in the camps. This should include income levels, employment opportunities, and access to financial services.

Table 9: Assess Refugee Economic Capacity

Activity	Implementation steps
Survey Design	Clearly define the objectives of the economic capacity assessment. Determine what specific information needs to be gathered about the refugees' financial situations. Develop survey questionnaires and tools to collect data. Ensure that these tools are culturally sensitive and inclusive, taking into account the cultural and ethnic backgrounds of the refugee population.
Data Collection	Determine the sampling methodology to ensure that the survey is representative of the entire refugee population. Consider random sampling or stratified sampling. Recruit and train a team of enumerators or data collectors who are familiar with the local language and culture. They should also be trained in ethical data collection practices.

Economic Indicators	Collect data on refugees' sources of income, including wages, remittances, and any entrepreneurial activities. Determine their average income levels. Assess the availability of formal and informal employment opportunities within and outside camps Examine refugees' access to financial services such as banking, microfinance, or savings groups.
Vulnerable Groups	Identify vulnerable subgroups within the refugee population, such as female-headed households, the elderly, people with disabilities, and households with dependents. Understand the unique challenges and needs of these vulnerable groups in terms of economic capacity.
Data Analysis	Clean and validate the collected data to ensure its accuracy and reliability. Use statistical methods to analyse the data and derive meaningful insights. Calculate average income levels, employment rates, and other relevant economic indicators.
Reporting	Prepare a comprehensive report summarizing the findings of the economic capacity assessment. Use data visualization tools to make the findings accessible to stakeholders.
Targeted Interventions	Based on the assessment findings, design targeted interventions that address the specific economic needs of the refugee population. Ensure that the interventions are tailored to the unique circumstances of different refugee groups, especially vulnerable ones.

Community Engagement	Organize feedback sessions with refugee communities to share the assessment results and gather their input on the proposed interventions. Communicate the importance of the economic capacity assessment and how it will inform support programmes.
Continuous Monitoring	Establish a system for ongoing data collection to monitor changes in the economic capacity of refugees over time. Create mechanisms for refugees to provide feedback on the effectiveness of the interventions and suggest improvements.
Privacy and Ethics	Ensure data privacy and protection measures throughout the assessment process, especially when dealing with sensitive financial information. Conduct the assessment with a strong commitment to ethical data collection, respecting the rights and dignity of refugees.

Recommendation 3: Subsidized Pricing Structure

Implement a subsidized pricing structure for utility services, where refugees pay a portion of the cost while international organizations or donors continue to cover the remaining expenses. This can ease the financial burden on refugees while gradually introducing a cost-sharing model.

Table 10: Subsidized Pricing Structure

Activity	Implementation steps
Cost Analysis	Conduct a thorough analysis of the current expenses associated with providing utility services to the refugee camps. This should include costs for infrastructure, maintenance, operations, and administration. Consider future projections for utility costs, factoring in potential changes in demand or infrastructure requirements.

Pricing Structure Design	Develop a clear and transparent pricing structure that outlines how the cost-sharing model will work. Ensure that refugees understand how fees are calculated and how subsidies are applied. Consider a tiered pricing structure where those with higher income levels pay more while ensuring that vulnerable groups receive additional support.
Subsidy Calculation	Calculate the subsidy levels required to make utility services affordable for refugees. The subsidy should cover a portion of the total costs. Strive to strike a balance between reducing the financial burden on refugees and ensuring the long-term sustainability of the services.
Pricing Structure Design	Develop a clear and transparent pricing structure that outlines how the cost-sharing model will work. Ensure that refugees understand how fees are calculated and how subsidies are applied. Consider a tiered pricing structure where those with higher income levels pay more while ensuring that vulnerable groups receive additional support.
Communication and Education	Launch communication campaigns to inform refugees about the new pricing structure, its benefits, and how subsidies will be applied. Offer financial literacy training to refugees, helping them understand how to manage their utility expenses within the new pricing framework.
Gradual Implementation	Create a clear timeline for the gradual implementation of the pricing structure. Specify when and how the fees will increase over time. Begin with small fees or charges and increase them incrementally. This gradual approach allows refugees to adapt to the new costs.
Fee Collection Mechanisms	Offer flexible payment options, including cash, mobile money, or other accessible methods. Ensure that refugees have convenient ways to pay their utility bills. Implement transparent billing practices to build trust among refugees and minimize disputes.
Grievance Mechanisms	Set up mechanisms for refugees to raise concerns or disputes related to their utility bills. Ensure that these channels are accessible and responsive. Develop a fair and transparent process for resolving billing disputes promptly.
Monitoring and Evaluation	Continuously monitor the impact of the new pricing structure on refugees. Assess whether it remains affordable and whether any adjustments are necessary. Gather feedback from refugees about their experiences with the pricing structure and any challenges they face.

Review and Adjust	Remain open to adjustments based on feedback and changing circumstances. If necessary, revise the pricing structure or subsidy levels to better meet the needs of refugees.
Sustainability Planning	Determine how the collected fees will be allocated to cover operational costs and maintain or improve the quality of utility services. Explore options for long-term financing, which may include revenue-generating projects or partnerships.

Recommendation 4: Targeted Assistance

Identify vulnerable groups among the refugee population and host community, such as female-headed households, the elderly, or people with disabilities, and provide targeted assistance to ensure they can afford utility services.

Table 11: Targeted Assistance

Activity	Implementation steps
Identification of Vulnerable Groups	Collaborate with community leaders and social workers to identify vulnerable subgroups within the refugee population. Common vulnerable groups may include female-headed households, the elderly, people with disabilities, and households with dependents.

Needs Assessment	Conduct a comprehensive needs assessment for each identified vulnerable group to understand their specific challenges and financial situations. Determine the extent to which utility costs (or planned costs) may be affecting these groups.
Targeted Assistance Programmes	Design and implement targeted assistance programmes tailored to the unique needs of each vulnerable group. Consider both short-term and long-term support measures.
Financial Support	Offer financial assistance, subsidies, or grants to vulnerable groups to help cover their utility costs. Ensure that the support provided is sufficient to make utility services affordable.
Inclusivity and Accessibility	Ensure that the targeted assistance programmes are inclusive and accessible to all members of vulnerable groups, including those with disabilities. Remove barriers to accessing support.
Monitoring and Evaluation	Establish mechanisms to monitor the impact of targeted assistance programmes on vulnerable groups. Collect feedback from beneficiaries to assess the effectiveness of the support.
Adjustments and Adaptations	Remain flexible and ready to adjust assistance programmes based on changing circumstances or emerging needs among vulnerable groups. Continuously assess and refine support measures.

Communication and Transparency	Communicate transparently with vulnerable groups about the support available to them. Ensure that they are aware of how to access assistance and whom to contact for help.
Empowerment and Involvement	Involve members of vulnerable groups in decision-making processes related to assistance programmes. Empower them to voice their concerns and preferences.
Continuous Assessment	Continuously assess the economic situation of vulnerable groups to determine when they may be ready to transition to a more self-reliant status. Gradually reduce assistance as appropriate, while ensuring they remain financially stable.

Recommendation 5: Income Generation Programmes

Implement income generation programmes and vocational training opportunities within the camps to help refugees increase their earning potential.

Table 12: Income Generation Programmes

Activity	Implementation steps
Programme Development	Identify the skills, resources, and economic opportunities that are relevant to the refugee population and the local context. Develop income generation programmes that align with the identified skills and opportunities.

Vocational Training	Offer vocational training programmes that provide refugees with the practical skills and knowledge needed for employment or entrepreneurship. Customize training to meet the specific needs and interests of participants.
Skill Diversification	Encourage skill diversification to enhance refugees' employability and income-earning potential. Consider offering training in various sectors, including agriculture, small-scale manufacturing, and service industries.
Access to Resources	Facilitate access to resources required for income generation, such as tools, equipment, raw materials, or small business grants. Collaborate with local businesses or NGOs to provide resources.
Entrepreneurship Support	Provide support for refugees interested in starting their own businesses. Offer entrepreneurship training, mentorship, and access to microfinance or small business loans.
Market Linkages	Establish connections with local markets and businesses to help refugees sell their products or services. Explore partnerships with local businesses for mutually beneficial arrangements.
Cooperative Enterprises	Encourage the formation of cooperative enterprises among refugees, where they can pool their resources and skills for collective income generation. Provide training on cooperative management and governance.
Financial Literacy	Include financial literacy education as part of the income generation programmes. Teach refugees about budgeting, savings, and responsible financial management.

Gender Considerations	Ensure that income generation programmes are accessible and beneficial to all genders, addressing any gender-specific barriers. Promote gender equality and women's economic empowerment.
Sustainability Planning	Develop sustainability plans for income generation programmes, including strategies for continued funding and resource allocation. Explore opportunities for refugees to contribute to the local economy.
Collaboration	Collaborate with local authorities, NGOs, and businesses to create a supportive ecosystem for income generation within the camp and in nearby communities.

Recommendation 6: Community Involvement

Engage refugee communities in discussions about the transition. Seek their input on how the process can be made more manageable and fair. Encourage community leaders to play a role in communication and cooperation.

Table 13: Community Involvement

Activity	Implementation steps
Community Meetings	Organize regular community meetings within the refugee camps to provide a platform for refugees to voice their concerns, ask questions, and share their perspectives on the transition.

Transparent Information Sharing	Ensure transparency in communication by sharing clear and accurate information about the transition process, including timelines, reasons, and potential changes.
Refugee Representatives	Encourage the selection of refugee representatives or community leaders who can serve as liaisons between the refugee community and authorities. These representatives can facilitate discussions and ensure that the voices of refugees are heard.
Feedback Mechanisms	Establish mechanisms for refugees to provide feedback and suggestions about the transition process. This can include suggestion boxes, dedicated hotlines, or online platforms.
Conflict Resolution	Develop a conflict resolution mechanism to address disputes or conflicts that may arise during the transition. Ensure that the process is fair, impartial, and accessible.
Empowerment	Empower refugee communities by involving them in decision-making processes related to the transition. Seek their input on policies and strategies that affect their lives.
Education and Awareness	Conduct educational sessions and awareness campaigns within the camps to help refugees understand the broader context of the transition, its implications, and the importance of cooperation.
Coordinated Efforts	Collaborate with local NGOs, community-based organizations, and international agencies to facilitate community involvement and support.
Conflict Mediation Training	Train community leaders or representatives in conflict mediation and negotiation skills to help resolve issues and disputes at the community level.

Communication Channels	Establish multiple communication channels, including written materials, radio broadcasts, and social media, to reach refugees with important information and updates.

Recommendation 7: Advocacy for External Funding

Advocate with UNHCR and other humanitarian organizations for continued external funding to support refugees during and after the transition. Emphasize the importance of maintaining basic services for vulnerable populations.

Table 14: Advocacy for External Funding

Activity	Implementation steps
Needs Assessment and Budgeting	Conduct a thorough needs assessment to determine the financial requirements for providing essential services to refugees during and after the transition. Develop a comprehensive budget that reflects the costs of maintaining these services.
Data-Driven Advocacy	Utilize data and evidence from monitoring and evaluation to support your advocacy efforts. Highlight the positive impact of continued external funding on the well-being of refugees.
Partnership Building	Strengthen partnerships with UNHCR, international donor agencies, and other humanitarian organizations that have a vested interest in refugee welfare. Collaborate on joint advocacy initiatives to secure funding.

Clear Communication	Communicate the potential consequences of reduced funding on the well-being of refugees, emphasizing the importance of continued support. Use compelling stories and real-life examples to illustrate the impact of external funding.
Policy and Research	Conduct policy research and analysis to demonstrate the cost-effectiveness of providing essential services to refugees in terms of long-term stability and security. Advocate for policies that prioritize refugee support.
Engage with Donors	Engage directly with donor governments and organizations through meetings, conferences, and advocacy campaigns. Present well-documented proposals that highlight the specific funding needs of the transition process.
Coordination and Consensus	Work collaboratively with other stakeholders to build consensus on the importance of continued external funding. Create a unified front for advocacy efforts.
Highlight Vulnerable Groups	Emphasize the vulnerability of specific refugee groups, such as children, women, the elderly, and people with disabilities, who rely heavily on external support.
Long-Term Vision	Present a long-term vision for refugee well-being that goes beyond the immediate transition, demonstrating how continued support can lead to self-reliance and sustainable development.
Documentation and Reporting	Provide regular reports and updates on the impact of external funding, showcasing success stories and demonstrating accountability.
Grassroots Engagement	Mobilize grassroots support by involving local communities and civil society organizations in advocating for refugee assistance.

CONCLUSIONS

The study provides an in-depth analysis of the transition from water trucking towards sustainable, utility-led water service models in two locations with long-term refugee populations over a 10-year period. Key findings are:

01 Infrastructure Development

Significant advancements have been made in water infrastructure, catering to increasing populations of both refugees and host communities, while addressing the unique challenges faced in these environments. In Itang, improved infrastructure enabled the quantity of water produced to increase from around 700 m3 per day to over 4,000 m3 per day during the three phases.

02 Sustainability and Integration

The study provides an example of developing sustainable, integrated approaches to water service delivery in refugee and host communities. This includes a shift from emergency responses, including trucking, to long-term, resilient infrastructure development. This also necessitates the appropriate institutional structures and policy modifications at both national and sub-national levels. In Itang, the system evolved from low functioning with frequent breakdowns to a highly reliable and well-functioning system, overseen by a board that enhanced both external and internal accountability mechanisms.

03 Adoption of conflict sensitive and peace building approaches

To develop an integrated system design, conflict resolution mechanisms as part of the environmental and social management framework to address disputes or conflicts that may arise during the transition are essential in the success and sustainability of the integrated utility model in conflict-affected contexts.

04 Service Level Improvements

Improvements in water production and delivery have directly contributed to increased levels of water services, enhancing living conditions, health, and well-being in the refugee and host community areas. In Itang, the quality of water has significantly improved, from a situation drastically lacking safe water, to greatly improved quality of water aligned with international standards for drinking water. The quantity of available water and its accessibility has increased both in the camps and host communities, and similarly the time needed to collect water has reduced significantly through the phases.

05 Cost and Financing

The analysis of cost management and financing models offers valuable insights into the economic aspects of sustainable water service delivery with significant cost benefits over a reasonable system lifespan. The Itang case demonstrates a significant decrease in the expenses associated with water provision. In the span of a decade, the cost per cubic meter (m3) of water supplied has dropped from $11.38 to $0.93, marking a 92 per cent reduction. The initial phase, which involved transitioning from emergency water trucking services to a permanent water system managed by an NGO resulted in a seven-fold decrease in cost. The second phase which mainly consisted of transitioning from NGO to utility managed operations has contributed to an additional 34 per cent cost saving per m3 of water produced. The solarization of the pumping stations in 2024 brought about further reductions.

06 Diversification of power sources

Improvements in the production and distribution system enabled the diversification of power sources. In Itang, initially all water was pumped up with diesel generators and trucked to the camps. In the third phase, the system utilizes a combination of solar, grid, and diesel power. This not only lowers operational expenses but also enhances system reliability and reduces the reliance on fuel delivery, which has proven to be affected by access restrictions due to safety issues over recent years.

07 Utility-Led Model

The success of the utility-led water provision model in these contexts underscores their effectiveness in ensuring long-term sustainability and operational efficiency, albeit with the need for sustained financing and subsidy being a key issue to address.

08 A utility-led model for water provision

This model is designed to provide integrated sustainable services to both refugees and their hosts, to mitigate key conflict dynamics and contribute to the social cohesion and peace between different population groups and between displaced persons and host communities. In Itang, efforts were made to strengthen the risk management capacity of the utility, for example by ‘contingency planning’ to address service gaps, and grievance management by the utility, which resulted in an improvement in collaborative engagement of the key stakeholders.

09 Global Implications

Long-term sustained services for refugees and host communities need predictable funding. Current humanitarian funding is not well suited to this task and new financing solutions must be developed to reduce pressures on emergency budgets which hinders responses elsewhere.

10 Future Recommendations

The study concludes with recommendations for future initiatives, emphasizing the need for continuous innovation, collaboration, and commitment to the Sustainable Development Goals in water service management.

This analysis serves as a resource for stakeholders in the WASH sector, providing a blueprint for similar initiatives globally and contributing to the broader discourse on humanitarian response in refugee-hosting areas.

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