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ORET Evaluation 2007-2012 – Case Studies of the ORET Transactions GH00028, GH00124, GH00137, GH00145, GH/WM07094 and SD00003

Drinking Water Infrastructure Projects in Ghana and Sudan

Dr. Elena Gross
Dr. Bernardin Senadza
Louis Sitsofe Hodey
Salma Abdalla

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Introduction and Methodology

This report presents the results of the evaluations of three case studies consisting of five ORET supported transactions in the water sector in Ghana: 1) Kwanyaku Water Supply System (GH00028 and GH00145) and Kasoa Interconnection Project (GH/WM07094); 2) Barakese Water Supply Project (GH00137); 3) Tamale Water Supply Project (GH00124). The five transactions share the same objective, namely improving access to potable drinking water for the population in the relevant regions with a view to improving their health situation and living standards, including saving time for women. In combination, this should offer better income and employment and opportunities for private sector development, at the same time resulting in less environmental stress.

The focus of the projects was on construction and rehabilitation of water treatment plants, distribution pipes and standpipes. Therefore the evaluation concentrated on water production and distribution and water quality at the points of sales rather than also evaluating health outcomes at the end-user level. The evaluations were conducted on the basis of desk research (of ORET archives and additional reports provided by the Ghana Water Company (GWCL) and staff of the water treatment plants), semi-structured interviews (with institutions and contractors), focus group discussions (with staff groups), and interviews (of water vendors and end users of water).

In addition, a survey of operators of standpipes was conducted in the Kwanyaku catchment area. It was designed on the basis of qualitative work to investigate the water vending at the standpipes constructed in the Kwanyaku area. To compare ORET standpipes, all public water sources available to the population were inventoried in July 2014, revealing a total of 336 water sources in 35 small towns and villages in the area. Most water sources are privately owned and operated, while the standpipes of the ORET-supported project have a mixed public/private operational system of management by public water committees and operation by private operators. Using the census data as a sample frame, 156 standpipes were randomly selected: 47% were ORET project standpipes and 53% were owned by private water vendors. The sample included all working ORET standpipes, as 35% of ORET standpipes turned out not to be in operation anymore. Owners and operators of the 156 standpipes were surveyed by means of a structured questionnaire on financial and institutional aspects of the private and public water market. In addition, in August 2014 water quality was tested for pH, colour, turbidity, conductivity, temperature, residual chlorine and *E. coli*.

The Kwanyaku Project

Kwanyaku I (GH00028) and Kwanyaku II (GH00145) were two related projects. Activities started in 2003 and 2006 respectively and were completed in 2010 and 2011 respectively. Kwanyaku I built a water purification system and pumping stations and expanded the existing distribution network in the catchment area. Kwanyaku II extended the network to Senya Bereku. The Kasoa Interconnection Project (GH/WMO7094) (Kwanyaku III) complemented the other two projects. It started in 2008/9 and was finished in 2013. This project installed a transmission and distribution network and constructed a 500m³ water reservoir, small-scale public sanitation facilities and standpipes, to improve the water supply in communities in the Kwanyaku catchment area. Across various communities a total of 122 public standpipes was constructed to supply the population with piped water.

The Barakese Project

The Barakese project (GH00137) rehabilitated the existing Barakese water treatment plant that together with the Owabi water treatment plant supplies drinking water to Kumasi, the capital of the Ashanti Region. Two new production modules were constructed with a production capacity of 27,300 m³/day each. A new booster station with a 2500 m³ reservoir along the transmission line and a new reservoir in Suame were installed to guarantee better water supply in times of power cuts and plant breakdowns. The existing distribution system, mainly the transmission mains between the water treatment plant and sub-networks, was rehabilitated and extended. To monitor the system, 60 zonal meters were installed. The original contract given to Taylor Woodrow included only one new module, but a second one was added when the second transaction was approved in 2010. The second transaction was added to the existing transaction. The beneficiaries of the Barakese water installation are the inhabitants in and around Kumasi: an estimated 2.1 million people. The objective was for the inhabitants of this metropolitan area to gain better coverage, a higher supply rate and additional access to potable drinking water.

The Tamale Project

The Tamale project rehabilitated the existing water plant (20,000m³/day) near Tamale and constructed a new plant with a daily production capacity of 25,000m³ located next to the existing plant. Raw water is extracted from the White Volta River, treated at the plant and then piped to Tamale through a 25 km distribution pipeline. In addition, a new reservoir, a new transmission station and distribution pipelines were constructed. The new transmission pipeline conveys water directly to town, whereas the old pipeline distributed water to the villages along the way, which resulted in extreme water pressure losses. The existing transmission pipeline supplying the corridor villages was also rehabilitated and water meters were installed. The aim was for the Tamale metropolitan area and the region around the capital of the Northern Region to gain better access to water by increasing the number of household connections and the supply rate. The project did not include end-user level interventions such as standpipe construction. Technical assistance focused on technical and institutional strengthening of the plant and the regional office of GWCL.

The Client

The main client of all transactions was Ghana Water Company Ltd. (GWCL), a 100% state-owned limited liability company. Investment in water infrastructure is not financed from its investment budget, however, but directly by the Ministry of Finance (MoF) as part of the government policy to keep water prices low. The tariff structure for water sales is supposed to cover only the costs of operation and maintenance (staff, operation of treatment plants and distribution systems, spare parts, chemicals, etc.). To augment the investment cost funded by the government, other investment funding was sought from donors. As a result GWCL already had extensive experience with ORET: treatment plants at Sekondi-Takoradi, Weija, Tamale, Cape Coast, Kwanyaku and Baifikrom have been constructed, rehabilitated or extended with funding from ORET grants and commercial financing guaranteed and serviced by the MoF.

The organisation of GWCL is centralised, with the head office in Accra. Regional offices manage the urban areas of the ten regions of the country but have to report monthly figures on production, cost and demand for chemicals to the head office. Monthly budgets are allocated to the regions; management of spare parts is also centralised via the main depot in Tema, east of Accra. Allocation of responsibilities within GWCL is not very transparent. Administrative processes are slow and bureaucratic, with hierarchy and lack of decentralised responsibilities hindering rapid responses to operational issues in the field. The financial statements of GWCL show a cumulative deficit built up over the years, with small profits only in 2010 and 2013. The total deficit at the end of 2013 was GHS 331.6 million (about € 80 million). Revenues from water sales are not sufficient to cover total expenditure on the production and distribution of water and to service foreign loans, while the increasing prices of imported inputs have contributed significantly to the increasing deficit.

Financing of the Transactions

The total sum of ORET grants for these transactions was € 60.3 million out of a total transaction amount of € 122.9 million. In the Kwanyaku projects the weighted average grant share was 42% compared with 53% for the Tamale and Barakese transactions. The financing structure of each water transaction is summarised in Table 5. ORET was attractive to Ghana for co-financing transactions in its drinking water sector because of the given the shortfall between the available and required funding and also the larger grant element of ORET after introduction of the Water Facility. The non-grant funds in the form of insured export credit loans, however, came at a relatively high price: the one-off financing cost (bank fees and the insurance premiums of Atradius not counting interest and amortisation) from 15.0% to 24.9% of the non-grant funds and for all five water transactions the weighted average was 18.9%. In the case of the Kwanyaku transaction GH00028, part of the export credits that financed content of less than 50% Dutch origin, was insured with the Belgian state insurance agency Delcredère for an premium amount of € 749,000, because the applicant company Denys was registered both in the Netherlands and Belgium.

Efficiency

With the exception of the Barakese transaction, the appraisal and execution of the projects went relatively smoothly, did not require more time than planned and compared well to the average ORET transaction. The water treatment plants and distribution systems were completed without significant delays, and outputs in other areas such as management and technical support were also realised as planned. In ***Kwanyaku*** the construction company Denys is still involved at its own expense, although technical and maintenance assistance in the ORET project ended in 2010. As a result, the plant is well monitored, though it is currently operating at only 65% of capacity. An extension of the distribution network and improvements to the transmission pipes would be necessary to increase production. Another production constraint is the frequent power cuts which halt production at the plant several times a day. The inventory located 118 of the 122 constructed ORET standpipes. It turned out that 42 of them (35%) are no longer in operation and almost half (20) were never connected to the system. Other reasons for defective ORET standpipes were breakdowns and no repair, non-payment of the water bill and therefore disconnection by GWCL, and other problems with GWCL. Despite the problems encountered, the ORET transactions increased water supply through public sources infrastructure in the area by one third.

The ***Barakese*** project faced quite a number of difficulties at the start. The project was originally assigned to Taylor Woodrow Construction BV (a special financial vehicle), with a Ghanese company as subcontractor (Taysec). Taylor Woodrow started the construction together with the engineering consultancy firm Royal Haskoning, which was responsible for design, supervision and training as part of the contract of the same ORET transaction. During the first year of construction Taylor Woodrow went bankrupt and the project was taken over by Ballast Nedam, which raises a question about the due diligence process of the first applicant. In the Grant Appraisal document it had already been noted that Taylor Woodrow was was "not very strong" and a "performance guarantee" was required to be provided by the mother company. Because the project was taken over about halfway and had not followed the methods preferred by Ballast Nedam (solid preliminary research, clear contract, etc.) modifications were considered necessary to the design and implementation. Given the late stage, this resulted in many last-minute changes and late orders. Despite these problems the project was completed on time. The ***Tamale*** water treatment plant was constructed on the basis of a turnkey contract and handed over in 2008. The implementation of the transaction went smoothly and this transaction was also finalised on time.

One of the main efficiency indicators for GWCL is the level and share of non-revenue water (NRW), i.e. water delivered without payments or lost in transmission due to leakages. Since 2011, GWCL has reported a decreasing trend in NRW: from 49% in 2008 to 46% in 2013. It blames physical losses (e.g. leaks from the pipes and network) for 50% of NRW, while the other 50% is assumed to be caused by "administrative" losses (e.g. illegal connections or manipulated meters). However, these estimates should be interpreted with caution, since the insufficient number of water meters in plants and major transmission pipelines makes it difficult to estimate how much water is in fact produced and reaches at certain points in the system. Meters are also often absent in private households or do not work properly, and the number of illegal connections is unknown.

The head office of GWCL reports that water quality is monitored regularly. The standard Ghanaian quality indicators for raw water (intake water from rivers at water treatment plants) are pH, colour, turbidity, alkalinity, iron, manganese, pesticide (nitrite), *E. coli*, cadmium, arsenic and chromium. The treated water quality indicators are pH, colour, turbidity, hardness, residual chlorine, total dissolved solids, sulphate, aluminium, iron, manganese, fluoride, nitrate, arsenic, nitrite and ammonia. From interviews with staff of the regional offices and by visiting the laboratories at the treatment plants we learned that the quality indicators of treated water are tested hourly as the GWCL regulation prescribes. Raw water is tested less frequently: monthly or every six months. It is advisable to do more frequent tests, particularly for heavy metals, e.g. for mercury. Surface water in Ghana (e.g.

rivers) is often contaminated by the gold mining industry, in which mercury is used extensively. A key performance indicator for mercury contamination is lacking.

Effectiveness and Impact

The theory of change of the projects assumed that the transactions would contribute to the supply of potable drinking water to the population of the relevant regions, with a view to improving their economic and social living conditions and their health. The three Kwanyaku transactions increased the volume of available drinking water in the respective regions and contributed to an improvement of the living conditions of the population. Furthermore, test done during the evaluation confirm that the water from the water production plants is generally of better quality than water from alternative sources (traditional wells and ponds). The survey of operators of the ORET standpipes shows that their water not only meets the quality requirements but is also cheaper than the water provided by privately owned standpipes. Hence the ORET standpipes have benefited their users, usually the poorer segments of the population. Overall the water supply distributed through ORET standpipes increased by about one third in the ***Kwanyaku*** region.

At user level, the management of standpipes in the treatment group is organised differently than that of the control group. Whereas 98% of the ORET standpipes are publicly owned, i.e. by the town population represented by the Water Committee, only 10% of the standpipes in the control group are publicly owned. The public ownership system involves rules on sales, revenue collection and responsibilities of Water Committees and water vendors. Operators of the ORET standpipes were usually selected by Denys upon recommendation of the local Water Committees. To become a responsible operator a person merely had to register with GWCL to receive the bill. Private water vendors pay about GHS 900 to get a standpipe connection, of which GHS 400 is paid to GWCL for being connected to the mains pipe and GHS 500 for the construction of the tap.

In ***Barakese***, the project was designed as a turnkey contract. Ballast Nedam handed over the treatment plant to GWCL in 2010, with one extra year of technical and maintenance assistance foreseen until 2011. Ballast Nedam had contracts with the Kumasi's water treatment plant before and after the ORET project. Administratively, the Barakese plant is well organised and its team is highly committed to produce water to high quality standards. The station manager is aware of the huge power problems and tries to save electricity where possible. Maintenance, such as cleaning the clarifiers and other installations, takes place regularly and the plant appears clean and well kept. The project has increased the production of safe drinking water for Kumasi by 40% and gave its inhabitants access to more drinking water of a high quality.

The ***Tamale*** plant is the only water production site in the Northern region. The project has increased water production by 25,000 m^3 per day, to more than double the volume produced before. An additional water treatment plant is urgently needed because with an average daily output of 44,000 m^3 the current plant is already producing at its maximum capacity of 45,000m^3. The staff is committed to producing water in large amounts and of good quality. Several steps in the improvised production process need revision as parts of the system are no longer functioning properly (e.g. intake pumps, chlorine and lime disinfection units, scraper bridges, and power factor equipment).

Despite the advantages of increasing the volume of drinking water available, certain aspects of the water supply system and related factors in Ghana have limited the effectiveness of the ORET transactions. First, water production is constrained by regular power outages in Ghana, low electricity voltage and weak high–lift pumps at the plants. Daily power outages form a clear risk for the sustainability of the plants. In addition, the weak pipelines cannot withstand the higher water pressure required to increase water distribution and they frequently burst. Another issue requiring attention is the financial and institutional weaknesses of GWCL; among other things, these result in production losses from delays in procurement of necessary inputs (chemicals) and poor management of spare parts.

Sustainability

A "*culture of maintenance*" is important to guarantee future water production is in accordance with international standards. Timely maintenance and proper repairs of equipment are of the utmost importance for the technical sustainability of the plant. Leakages in the distribution system are identified as a major concern throughout Ghana, and this is worsened by GWCL having no system to rapidly detect and manage breakdowns and burst pipelines. Another technical threat to sustainability of the network is the lack of standardisation in materials and spare parts for the distribution network. This poses serious problems for repairs because old and new pipes are not standardised so it costs more to connect them.

In ***Kwanyaku***, Denys has still one third of the plant staff (eight out of 25 employees) under contract to maintain the plant and support GWCL staff. These costs are borne by Denys itself. According to the local manager of Denys a technical and maintenance assistance period of two years, as was included in the transaction, is not sufficient to develop a "*culture of maintenance*". Another problem is that staff of GWCL often change jobs and knowledge is not transferred. There are no procedures for monitoring the operation of the plant: the first comprehensive inspection should have been done five years after its start-up but there has been no inspection to date. It is uncertain what will happen when Denys no longer provides technical support. If a standpipe breaks down, 75% of water vendors call a local technician to do repairs; there is no difference between the treatment and control groups. Only 20% of standpipe owners call GWCL for assistance and the remaining 5% call a technician from a nearby larger town or attempt to mend the pipe themselves. Private technicians appear to be much faster in providing repair services than GWCL. More than 50% of respondents in the treatment and control groups received prompt attention from the local technician upon request. In both groups 70% of respondents reported that the response of GWCL to such calls was either very slow or there was no reaction at all. There is no statistically significant difference between the treatment and control groups regarding the responsiveness of local technicians and GWCL. There is a statistically significant difference between ORET and private water standpipes in terms of number of days the standpipe was out of order during the last breakdown; 21 days for private water vendors and 45 days for ORET standpipes. The main reason for this difference is that ORET standpipe operators lacked sufficient funds to pay for repairs. 16% of ORET standpipe operators reported that they did not have sufficient funds to pay for repairs, compared with only 6% of private operators. This difference is statistically significant at a 10% level. The two groups do not differ statistically significantly in terms of the repair costs incurred during the last six months prior to the survey.

In ***Tamale***, Biwater handed over the plant in 2008 with a six-month period of additional technical and maintenance assistance. This was not sufficient to develop a "*culture of maintenance*" among the local employees. Local management was also reluctant to handle the new technologies in an appropriate manner, in particular the new chlorine and lime installations, which need additional backflushing of the system in situations of frequent power outages in Tamale. Spare part management was not functioning properly either, which threatens the technical sustainability of the plant. In ***Barakese***, the current production has not yet reached its maximum capacity, but this shortfal is mainly due to power cuts and the inadequate transmission mains that cannot handle larger quantities of water. The planning for an extension of the distribution network is ongoing but this project is hampered by financial constraints.

Water Tariffs and Social Aspects

Access to safe drinking water is very important for the population of Ghana and its policy makers. To meet population growth and increasing water demand, the water system will have to be constantly improved. For this to happen, it is necessary that all people benefitting from the water treatment plants also pay for the water they consume. Illegal connections, manipulated meters and a non-payment culture for water pose clear threats to the sustainability of the water system. The current water tariff structure of GWCL is a serious threat to the financial sustainability of the system. Tariffs are far too low to cover the operational costs and salaries of the water plants, even disregarding the costs for maintenance. Actual water consumption is often not paid in full by end users, especially in areas where richer people live and where flat rate tariffs have existed for a long time. All three water plants discussed here face financial problems, with serious consequences, in particular for their ability to procure spare parts. In contrast to the general situation, all but two of the standpipes observed during the survey have a working meter. On average, about 80% of respondents in the treatment and control groups indicated regular billing by GWCL; another 15% indicated that they are billed more or less regularly. About 5% of operators in the control group indicated that they have never been billed. There is no significant difference between the treatment and control groups regarding the frequency of receiving water bills. Standpipe owners and responsible operators who receive bills pay the water bills to GWCL directly.

There is a statistically significant difference between the average price charged to end users of ORET standpipes and the price charged by private water vendors. The mean price for a 34 litre container of water is GHS 0.14 for the control group and GHS 0.12 for the treatment group; this difference is statistically significant at the 5% level. There is no statistically significant difference between the treatment and the control group in the mean quantity of water sold. In the control group both the calculated mean and the self-reported monthly revenues from water sales are somewhat higher than those of the control group but not significantly so, implying that both groups earn comparable revenues. The calculated mean revenues for both the treatment and control groups are higher than the self-reported mean revenues. This suggests that revenues are underreported. In summary, compared to privately operated standpipes, the tariffs for ORET standpipes are cheaper yet approximately the same volume of water is sold.

Regarding the poverty aspect of the transactions, the vendors of water from the ORET standpipes give poor people somewhat cheaper access to water because the price charged per container is lower. For standpipes in the treatment group the price is largely determined by GWCL, whereas the majority of the private standpipe owners in the control group set their own prices. For instance, 72% of respondents in the control group set their own prices, whereas 28% follow the price set by GWCL or the water committee. In contrast, 57% of respondents in the treatment group rely on GWCL or the water committee for price setting while 43% of the vendors in the treatment group set the prices themselves. The difference between the two groups in terms of price setting is statistically significant at a 5% level. The interviewed household heads revealed that they would be willing to pay GHS 100 for being connected to piped water and a monthly flat rate of GHS 20 for water consumption. At current water prices, a flat rate of GHS 20 would be advantageous if monthly consumption were above 3.5m³, disregarding time savings and convenience. It would, however, be impossible to connect a household to the mains for GHS 100: private owners had paid about GHS 528 for the installing of the pipes and tap. Strong political pressure is being exerted on the government to continue to subsidise and stabilise the price for drinking water, notwithstanding the increasing burden for the government budget of the debt service of foreign investment loans and the rising cost of imported inputs. At present, the low and flat water tariffs and uncollected revenues from non-revenue water end up favouring richer consumers, whereas the poorest pay the full price for each bucket of water – a load that they also have to physically carry.

Ecological

In ***Kwanyaku***, ecological standards are well maintained as Denys is still actively supporting the management of the plant. Sludge from the water treatment plant is properly disposed of and even used as fertiliser for mango trees, leading to extra income for the people living near the plant. When Denys leaves the plant, there is no guarantee that these standards will be maintained.

Water from the standpipes was found to be of high quality in terms of pH (average 6.88), residual chlorine (0.55 mg/L) and non-detectable faecal *E. coli*. The water tasted rather soft, with calcium and magnesium levels far below their respective thresholds of 100mg/L and 500 mg/L. Softer water is preferred by customers for washing because less soap is required for suds. Overall, the results of the 140 tested standpipes show that there are no health threats from the drinking water provided by the public and private water-vending standpipes. The water meets WHO standards (which are also the national standards) and this was confirmed in the interviews with end users. In ***Tamale,*** ecological standards are not well maintained at the plant: the sludge is not removed properly and is simply dumped close to the plant. This does not cause an environmental problem nor does it result in water of lower quality, but money is being wasted because the sludge could be used as fertiliser. Due to the lack of supervision, hygienic standards are not well followed. In ***Barakese***, ecological standards are well maintained: e.g. sludge is disposed of properly and the plant is well maintained and kept clean.

Relevance

According to the Ghanaian Ministry of Water Resources and Housing, water supply infrastructure is a key government priority. According to the Strategic Water Development Plan[1] the Government's target is to reach 85% urban water coverage and 76% rural coverage by 2015. As investment in water infrastructure is in line with MDG 7c, which is to reduce by half the population without access to improved drinking water and sanitation, the ORET projects in water infrastructure have been extremely relevant for human development in Ghana. Since 2003 Ghana has followed the Ghana Poverty Reduction Strategy (GPRS), in which one of the key priorities is increasing access to safe drinking water. According to the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, Ghana met the target on access to drinking water by increasing the proportion of the population served from 54% in 1990 to 87% in 2012. These investments were often also justified in terms of improving health, particularly to reduce diarrheal incidence in children under the age of five.

Additionality

Without the ORET grants probably none of the drinking water projects in Ghana would have been funded in a similar way. The attractive funding conditions (under ORET's Water Facility, a grant of 50% of the estimated cost) and the volume of available funds made ORET the main funder of drinking water projects in Ghana. An alternative could have been the World Bank loan of US$ 103 million in 2005, which also financed the Aqua Vitens Rand management contract for GWCL. But it is uncertain whether the same number of projects would have been funded under this loan. The transactions would very probably have been implemented, but with grants forming less than 50% of the funding, as was the case for other sectors in Ghana, with Ghana having to fund a larger proportion of the costs with commercial loans. For the Barakese water treatment plant in Kumasi an additional investment of € 12.5 million was made in 2010, fully financed by a commercial loan. This shows that it would have been possible for GWCL to find financing means other than grants, though probably on much less favourable terms and for smaller amounts.

Coherence

The Netherlands has focused on good water management worldwide because water management is one of the four main priorities of Dutch development cooperation policy[2]. It has contributed considerably to aid in the water sector globally: from 2006 to 2007 it made commitments of US$ 392 million in the water sector, which was about 11% of the total Dutch aid and amounted to 6% of total allocable aid in water and sanitation worldwide (OECD, 2008). Most water-related ORET transactions were co-funded by commercial export credits from Dutch banks that were insured by Atradius DSB against the risk of non-payment, though for a considerable price. In general the ORET transactions in the water sector in Ghana can be considered as being coherent with the policies and strategies of the recipient country and with the aid and export promotion of the Netherlands itself.

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[1] http://www.wsp.org/sites/wsp.org/files/publications/CSO-Ghana.pdf

[2] http://www.government.nl/issues/development-cooperation/the-development-policy-of-the-netherlands/water-management

Drinking Water in Sudan

Introduction and Methodology

This section describes the results of the evaluation of the ORET-supported Al Manara water treatment plant (SD00003) in Sudan that was part of the larger Omdurman Water Supply Project. The project is being implemented under a BOOT contract (Build, Own, Operate, Train/Transfer). For the project's ownership, Khartoum State Water Company (KSWC), FMO, and the UK-based contractor Biwater established a special purpose company in the form of a Public Private Partnership (PPP) with a capital-light structure: the Al Manara Water Company (AMWC). The Al Manara plant was constructed by Biwater, who still have a management contract with AMWC for its operation. The operation and maintenance of the treatment plant will remain under control of AMWC for ten years until the loans for the construction have been fully repaid, which is expected to be in 2020. Then the equity shares in Al Manara held by Biwater and FMO are to be transferred to KSWC.

The main objective of the Omdurman Water Supply Project was to improve access to potable drinking water for the population in the Greater Khartoum area with a view to improving their living standards. The project activities entailed constructing of the new drinking water treatment plant (which has a capacity of 200,000m^3 per day), transmission mains, a connection to the new storage reservoir (40,000m^3) and booster station at Al Thoura, and the connection to the existing storage in Al Gamayir. In addition, a Water Asset Management Programme (WAM) was put in place with a view to reducing the volume of unaccounted for water and to improve the distribution management, operation and maintenance. The ORET transaction focused in particular on the water treatment plant and the WAM; the other components, such as Thoura Reservoir, the transmission mains and the sludge treatment from the plant and everything else not associated with the water treatment plant were executed under a different contract.

The evaluation assessed six criteria: efficiency, effectiveness (impact), sustainability, relevance, additionality and policy coherence. Special attention was devoted to ascertaining whether the water institutions have the resources and capabilities to continue functioning after the plant has been turned over to KWSC. The evaluation was conducted on the basis of desk research (the ORET archives and additional reports provided by stakeholders in the project), semi-structured interviews with institutions and contractors, focus group discussions with staff groups and interviews with end users of water. In general, it was difficult to obtain relevant and reliable data from KSWC, especially financial reports. All results based on KSWC information have to be interpreted with care.

In addition, a survey was conducted among beneficiaries in the AMWC catchment area. The approach applied was a before-and-after method, with a control group added only in 2014. Although the before-and-after method has its limitations regarding impact measurement, because of the lack of information no other approach was feasible. A baseline survey was conducted in 2007 but only among beneficiaries of the Al Manara water treatment plant. Since it is also interesting to determine the effect of the water treatment plant on both beneficiaries and non-beneficiaries, a population in an area where households are not connected to the mains but obtain their water from vendors was sampled.

A household survey was conducted in August 2014 by interviewing 924 households in total in the Kararie Locality (Mahaliyya). Eighthundred households were part of a survey conducted in 2007 and were reinterviewed in 2014, while 124 households in Al Fateh were interviewed for the first time in 2014 to investigate the current situation of households not connected to the mains. Due to time and capacity constraints the team was only able to sample the water from 160 households.

The Client

KSWC, the client of the transaction, is a 100% state owned company responsible for providing potable water in the capital and Khartoum State. After a period that saw various administrative changes in the water sector in Sudan, KSWC was founded under the Water Sector Reform in 1994, becoming responsible for the water supply in Greater Khartoum. Administratively, KSWC is managed by a Management Board supported by a number of divisions that are responsible for Internal Audit, Legal Administration and Local Affairs. The company is divided into several units, among them the Project

Planning Unit, Water Resources Unit, Technical Affairs, Laboratories and Quality Control Unit. In total, KSWC employs 2778 people, 65% of whom are administrative staff and only 35% are technical staff – an illustration of the company's top-heavy structure.

KSWC runs 11 water stations that together produce 776,883m³ per day and serve the 5 million inhabitants of Sudan's capital city. Al Manara is the second largest plant in Khartoum and provides about 24% of the total daily water production in Khartoum. Since the population also uses boreholes (numbers unknown), KSWC estimates Al Manara's contribution to the total daily water production at 13%. KSWC is responsible for the distribution of the water produced in Al Manara. There are currently 154,337 private connections to Al Manara. The majority of customers (85,534) live in the Kararie Locality and are among the richer households. The other customers live in Omdurman (4,807 connections) and in the Ombadda Locality (63,998 connections). The only plant supplying water to these three areas is tha Al Manara plant.

Financing and Water Tariffs

The BOOT arrangement implies that the cost of construction was financed by a mix of an ORET grant and various types of loans. During the first ten years, the plant is being operated and maintained by AMWC and the water it produces has to be sold to KSWC at a price that is sufficient to pay the interest and to amortise the project loans, and to cover the operation, maintenance and management costs of the plant. Funding for the project was secured by a combination of approximately € 64 million "soft" loans from government-backed development banks in the Netherlands (FMO/IDF), South Africa (IDC) and Malaysia (Mexim), together with a € 24 million grant from ORET. The loans are provided for a period of 13 years, comprising an initial three year construction period followed by a ten year operating period. The BOOT contract enabled KSWC to extend the water infrastructure without making any initial capital investments ("capital-light"). Neither KSWC nor the Khartoum State Government nor the Federal Sudanese Government are supposed to pay anything until the BOOT contract ends, although the Federal Ministry of Finance has given a payment guarantee.

AMWC runs the plant on the basis of a "break-even" tariff that consists of two components: a capacity charge and a consumption charge. Both are euro-denominated and billed monthly to KSWC. The first component is based on the full capacity of the water treatment plant (200,000 m³/day). It covers repayments and interest charges on the loans and the fixed costs of operating and managing the plant, such as fixed electricity costs, salaries, management fees, administration and maintenance costs. It ensures that the lenders are paid back and that AMWC is paid independently of the volume of water produced, to cover the fixed costs. The second component is based on the actual water production by the plant and covers the variable costs of the water volume produced, such as electricity, chemicals and cost of sludge disposal. The combined tariff in the BOOT contract was € 0.2422/m³, composed of a capacity charge of € 0.1892/m³ and a consumption charge of € 0.053/m³. In 2014, the combined tariff was lower: € 0.2296/m³, split into a somewhat higher capacity charge of € 0.1902/m³ and a lower consumption charge of € 0.0394/m³.

KSWC is responsible for distributing the water to end users in Khartoum State and invoicing them. With the current water tariff system KWSC charges end users a flat rate per household per month based on the classification of residential houses[3] and the size of the connected pipe but regardless of the actual consumption. The flat tariff was based on estimates by KSWC of the average per capita water consumption per day in the three residential classes.[4] **Error! Reference source not found.** compares the monthly water tariffs in 2008 and 2014, which shows almost no change in tariffs except for the poorer class 3 connections, where the price even decreased. According to KSWC, fee collection

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[3] The three class water tariff system is based on the Khartoum town planning system, which classifies housing as first class (a surface area from 500 to 1200 m²), second class (an area from 400 to 700 m²), and third class (an area from 200 to 400 m²) (Shora Consultancy 2006).

[4] The daily per capita consumption figures are very high and do not seem realistic. They are derived from KSWC reports and the project documentation of the Al Manara project. Other estimates of daily per capita consumption range between 27 litres per capita per day in poor residential areas (Cairncross and Kinnear 1992) to 70 litres per capita per day in richer residential areas (Edge Consultancy 2007).

improved drastically between 2011 and 2014 after the introduction of a pre-paid system in 2012 that combines water and electricity. Now customers have to pay their bills at the beginning of each month in local offices of the Sudanese Company for Electricity Distribution, which falls under the Federal Ministry of Electricity and Water Resources.

Efficiency

The ORET grant and the concessional loans were disbursed on time. The implementation of the construction was successful in technical terms despite some delays in the work that occurred mainly because some imported construction materials were held up in customs. A crucial component of the project was the Water Asset Management Programme (WAM), which involved training the staff of Al Manara and KSWC in order to ensure efficient administration. During the training, which was provided by Biwater and Farrer Consultancy, it became clear that effective management of the water system would require essential information on the pipe network, such as maps of the pipe networks and flow meters,but there were none. So part of the funds for WAM went into developing a system for monitoring the network, and Biwater also installed a WAM system together with KSWC. Household properties were listed and the billing system was revised. Initially, only 96,000 customers out of a total of 254,000 connected households were billed. This rose to 145,000 in 2011 and in 2014 154,337 customers connected to Al Manara were being billed.

Production rose steadily after 2010 but downturned temporarily in the second half of 2013. Obstacles to increasing water production were the slow growth in new household connections and problems with transmission pipelines; KWSC was responsible for both. Since the decision to distribute water to the Al Gamayir and Al Thoura areas too, Al Manara has produced around 180,000m^3 of water per day, which is between 80–90% of its capacity. All water produced at the Al Manara plant is invoiced to KSWC. However, KSWC estimates that around 30-35% of water delivered to households in Greater Khartoum is unaccounted for. This percentage is the difference between the revenue from water sales to end users and the amount paid for produced water. This estimate could not be validated because KSWC did not make the figures for unaccounted for water available to the research team.

Water quality samples are collected daily at designated points at the Al Manara water treatment plant at the frequency stipulated by the BOOT Agreement. Samples are analysed in the laboratory on site to determine compliance with the primary parameters defined in the contract. The water also has to comply with the Water Supply (Water Quality) Sudanese Regulations and WHO Guidelines. Independent monitoring of the water quality is carried out by the Khartoum State Ministry of Health and KSWC. The parameters analysed once a day for both the raw water (from the Nile River) and the treated water are turbidity, pH, colour, alkalinity and temperature. Any deviation from the standards for drinking water results in immediate adjustments to the disinfection process at the plant. The population considers the water from Al Manara to have the best water quality in Khartoum.

Effectiveness

From a technical point of view, at the level of the water plant the project has succeeded in providing drinking water of high quality. In addition to constructing a new plant, transmission pipes to reservoirs were installed and a new reservoir was built in Thoura. At an average production of 180,000m^3 per day AMWC estimates that the plant serves around 1.2 to 1.4 million people. However, since water meters are lacking, it is not possible to validate either this figure or the daily consumption figures. Neither is it possible to report on the change in household connections, since KSWC did not make these figures available.

At beneficiary level, the problems most mentioned in the survey concerning the water supply in 2014 are frequent water cuts in general (38%), water cuts especially in summer (15%), and low water pressure (10%). 34% of respondents consider the price for water to be too high but only 8% mention bad water quality. Minor problems reported are administrative issues with KSWC (2%). 22% of respondents say they have no problems at all with their connection. In 2007 86% of households in the Kararie Locality had a piped connection; by 2014 this number had risen to 98%. The survey of the 124 households in Al Fateh, an area where KSWC planned to build piped connections in recent years, however, shows very different results. Here only 36% of the sampled households are connected to the mains and most of these were not connected until 2013. Most households in Al Fateh therefore do not have piped water and so buy water from donkey cart water vendors (88% of households in Al Fateh). These households usually buy the water in 25-litre jerrycans or in 200-litre barrels. The price per jerrycan ranges between SDG 1 (€ 0.14) and SDG 5 (€ 0.75), the cost per barrel ranges substantially: between SDG 15 (€ 2.1) and SDG 70 (€ 10). About 70% of households buying water from vendors had received all the water they demanded during the week before the interview. About 30% of households indicated that due to insufficient water availability or lack of financial means they could not buy all the water they needed for their daily needs.

The results of the water quality tests show that there is no residual chlorine in the water of the unconnected Al Fateh area. This indicates that the water people consume is either completely untreated or that all the chlorine to eliminate pathogens in the water has been absorbed. The higher turbidity indicates that water in Al Fateh is more often associated with higher levels of pathogens such as viruses, parasites and certain bacteria. This is confirmed by the *E. coli* indicator, which shows that 53% of households in Al Fateh consume contaminated water, compared with only 2% in the other areaes surveyed. The results of the self-reported water quality in the surveys in 2007 and 2014 show that in both periods 54 % of people connected to the piped system considered the water quality to be very good or good. Whereas in 2007 48% of the surveyed population regarded the water quality as insufficient, in 2014 only 27% regarded it as insufficient and 23% considered the water sufficiently good. For those households purchasing water from vendors, 70% perceive the water as very good or good quality, 5% as sufficient quality, but 25% regarded the water quality as being bad (19%) or very bad (6%).

Sustainability

Financial. From a financial perspective, the main challenge for AMWC is getting the loans repaid because KSWC does not always pay its water bills, or pays them late and these bills include the amortisation of the loans. The expectation that the loans will have been repaid completely by 2020 through the capacity charges in the water bills seems too optimistic. At the moment of writing this report (December 2014) repayment had halted. In response to these payment difficulties, the project lenders have given the guarantor – the Khartoum State Government – a waiver of its obligation to guarantee the repayment of the loan principal. Following a meeting in November 2014 to review the payment situation and seek a longer-term solution to the payment difficulties, the Khartoum State Government is now looking into a number of options for refinancing the project or even for arranging a buyout of the project.

An additional threat to financial sustainability is the flat rate scheme for consumers. Water tariffs have not been adjusted since 2008 whereas prices for goods and services have risen by 40%. All efforts by KSWC to increase the tariffs have failed because of strong political and consumer resistance. Another major disadvantage of this system is that consumption per payment class cannot be controlled and in the absence of water meters in private homes consumers have no incentive to economise on their water consumption. In practice the flat rate water tariffs households reported they are charged differ substantially from the official tariffs listed by KSWC. Richest households (class 1) pay far less for water than they are supposed to do, whereas on average the poorer households (class 3) pay the official tariff. The application of the tariff scheme seems to vary greatly over households: 18% of the households surveyed reported that they had not paid for water in the month prior to the survey. About 50% of the sample said they paid SDG 15, regardless of their residential class. Since 2012 the usual method for settling the water bill has been to pay as part of the combined pre-paid charges for electricity and water. Pre-paid payment now seems to be the norm, as 95% of households report paying this way. The 5% of households who report not paying in this way probably do not pay at all.

Technical. The Al Manara water treatment plant is considered to be the most advanced water treatment plant in Khartoum in terms of the state of its technology, laboratory facilities and other equipment. As the financial means for planned maintenance are lacking, however, an obvious threat is unforeseen breakdowns. KSWC does not have financial reserves to pay for any routine or emergency repairs.

The BOOT contract provides for the water treatment plant to be operated and managed by Biwater until 2020. Thereafter the plant will be fully transferred to KSWC. KSWC is often described as a weak institution which is managed by senior staff who are reluctant to delegate power. Administrative processes within the institution are not transparent, which poses a threat to sustainability in general. The BOOT contract foresees transfer of the staff at AMWC to KSWC as part of the transition of the facilities to Khartoum State. Due to the combination of the foreseen transfer of at least a large part of the staff and the long period of working together with Biwater, the handover of the water treatment plant to Khartoum State in 2020 should not face major problems. Whether the ten-year joint operation and management period will be sufficient for a "culture of maintenance" to take root remains a matter for further investigation.

Ecological. Compared to other water treatment plants operating in Khartoum, Al Manara is the most sound from an ecological point of view. It uses modern techniques and applies international standards for operating the plant and producing drinking water. As Biwater is still managing the plant, the hygienic standards are well maintained. Whether these high standards will be maintained after 2020 is uncertain.

Social. The cost of connecting a household to piped water is paid by the end user but differs per residential class, ranging between SDG 1 and SDG 4 per metre of pipe laid between the household and the main transmission pipe. Households in class 1 pay SDG 4 per metre for a 1 inch diameter connecting pipe, class 2 households pay SDG 2 per metre for a ¾ inch diameter connecting pipe, and class 3 households pay SDG 1 per metre for a ½ inch diameter connectin pipe. KSWC has delegated the connection of household to "popular committees" (lowest administrative level responsible for social services in neighbourhoods) so that it can collect connection fees from one source. People in Al Fateh complained that this administrative arrangement is susceptible to corruption practices that disadvantage poorer people. In interviews people mentioned the common practice of "popular committees" arbitrarily charging higher connection fees to generate income for themselves.

In 2009/2010 there were also several demonstrations and attempts by the population of Greater Khartoum to resist the planned increase of water fees by KSWC. In contrast to the installation of electricity meters, the installation of water meters proved controversial among the population of Greater Khartoum. KSWC has installed a few meters in business and industrial areas but has so far failed to do so in residential areas. Water in Khartoum remains a very sensitive issue, especially during summer and Ramadan when people become more agitated about having an adequate water supply. Water supply is a daily concern for most people and a politically sensitive issue for policy makers.

Relevance

The ORET project in water infrastructure is regarded as being most relevant in water-distressed Sudan because of the impact of reliable and quality drinking water on public health and social development. Water supply is also very important for political stability. According to the National Five-year Plan (2012 – 2016) of March 2012, water management is still a high priority, with government policy aiming to provide clean drinking water to the population in all states. As the Al Manara water treatment plant provides 24% of water production to Greater Khartoum, the ORET programme has contributed significantly to water improvements in the area.

Additionality

Without the ORET grant, the Al Manara project would not have been realised. The grant was crucial in the overall financing structure of AMWC due to the unavailability of funding at KSWC. It also played a catalytic role in mobilising other funds for the larger Omdurman Water Supply Project. The 55% grant component for the ORET part was very favourable for KSWC, enabling it to pay lower tariffs for the water produced by the water treatment plant and to charge lower prices to end users. The attractive financing conditions and the establishment of AMWC for management and operation both contributed greatly to increased water supply in Greater Khartoum.

While the BOOT contract for AMWC offered the benefit of a huge investment and small capital outlays up front for the client KWSC, it has not provided a magic solution because of some basic flaws in the financial design. The most important problem is the currency mismatch between on the one hand the euro-denominated loans and water tariffs that KWSC pays to AMWC (in particular the capacity charge) and on the other hand the intended repayments from water revenues collected in local currency from newly connected customers. Another problem is that AMWC has no control over the number of newly connected customers and the water tariffs whereas the product of new connections times invoiced water in the form of water revenues is a critical element of the prize-winning financing model of AMWC.

Coherence

The Netherlands has contributed considerably to aid in the drinking water sector globally. In the period 2006 to 2007 it made commitments of US$ 392 million in the water sector, which was about 11% of the total Dutch aid and amounted to 6% of total allocable aid in water and sanitation worldwide (OECD, 2008). The Al Manara plant was responsible for meeting a considerable part of the pledge of Minister van Ardenne to increase the number of people having access to safe drinking water under MDG7c. The financing structure of Al Manara did not require the insurance of a related export credit nor the financing of preparatory cost of the project since these costs were borne by FMO, which financed the project from the two concessional development funds (ORET and IDF) it was managing at the time on behalf of the Dutch government.

1. Introduction

This report contains the evaluation results of six drinking water transactions in Ghana and Sudan that were co-financed by the ORET programme. These transactions are: 1) Kwanyaku Water Supply System (transactions GH00028 and GH00145) and Kasoa Interconnection Project (transaction GH/WM07094); 2) Barakese Water Supply Project (transaction GH00137); 3) Tamale Water Supply Project (transaction GH00124) and 4) Al Manara Omdurman Water Supply Project (transaction SD00003). The evaluation includes surveys among the beneficiaries in four of these transactions: the three interrelated transactions under the Kwanyaku Supply Project in Ghana (GH00028, GH00145 and GH/WM07094) and the Omdurman Water Supply Project (SD00003) in Sudan. In both projects a new water treatment plant was constructed.

In Ghana, the Kwanyaku plant was rehabilitated and extended by the Belgian company Denys. In Sudan, the Al Manara plant was constructed by the British company Biwater. What makes the projects similar is the technical component of the water treatment plants that are constructed by European engineering consortia. The differences between the two projects are the role of the national water authorities and the financing structure. In Ghana it was a turnkey contract whereas the Sudan project was conducted under a BOOT contract (Build, Own, Operate, Train/Transfer). For this last project Khartoum State Water Company, FMO and the contractor Biwater established a special purpose vehicle company in a Public Private Partnership (PPP): the Al Manara Water Company (AMWC). In contrast to the Ghanaian project, Al Manara is today still managed by Biwater until the loans are paid back. The final date for transferring operation and management of the water treatment plant to Khartoum State Water Company (KSWC) is, according to the repayment scheme, 2020. In Ghana, the water treatment plant was turned over to the Ghana Water Company Ltd. (GWCL) after its construction was finished in 2012. No management responsibilities were taken over by the construction company or any other supporting agency. GWCL is responsible for management, operation and maintenance of Kwanyaku from the moment the construction works and technical and maintenance assistance (TMA) were completed, though Denys remains involved with technical support to the plant. The two other transactions in Ghana, Tamale and Barakese, were similar turnkey contracts that were completed in 2008 and 2010 respectively

In order to achieve full success of the water treatment plants, formidable challenges still remain. These challenges are mainly related to the institutional side of the water provision. This is not only a matter of the national water authorities taking full responsibility for the provision of clean drinking water to consumers. It also requires sustainable financial and administrative systems with appropriate water tariffs where water bills are actually collected so that the water companies can operate and maintain the service, pay their employees regularly and reduce the amount of unaccounted for water.

The remainder of this report is structured as follows. Section 2 gives an overview of the drinking water situation in Ghana and Sudan and the national water tariff systems in urban areas. Section 3 describes the respective national water authorities and section 4 illustrates the inputs financed by the six ORET transactions before section 5 presents the financing packages. Section 6 depicts the theory of change, the evaluation criteria and the information sources for the evaluation. Based on the evaluation methodology, section 7 presents the results of the ORET transactions. Section 8 discusses factors going beyond the scope of the projects but that affect the outcomes and long term results. Section 9 discusses the evaluation criteria relevance, additionality and coherence. Finally, section 10 summarises the main findings and presents some recommendations.

2. Drinking Water Situation

2.1. Ghana

Figure 1 depicts the drinking water situation of Ghana as a whole compared to the situation in the Central Region, where the Kwanyaku plant is located, the Ashanti Region with the Barakese treatment plant, and the Northern Region with the Tamale treatment plant. The data is taken from the 2008 Demographic and Health Survey in Ghana and shows the situation before the ORET financed and rehabilitated water treatment plants came into operation. As the graph shows, 60% of the population in the Central Region uses public standpipes as their main drinking water source which is far above the national average of 38%. In the Northern Region the majority of people still rely on unprotected sources and public standpipes and only few households have a private connection. An alternative for unprotected sources and public standpipes are expensive sachet water bags (200-1000ml water bags) that are usually produced with piped water from the water plants. These figures can be used as quasi-baseline values that can be compared with the figures collected during this evaluation. The goal of the ORET water projects was to improve water supply and access to water for the population in these three regions of Ghana.

Figure 1: Drinking Water Sources Ghana 2008

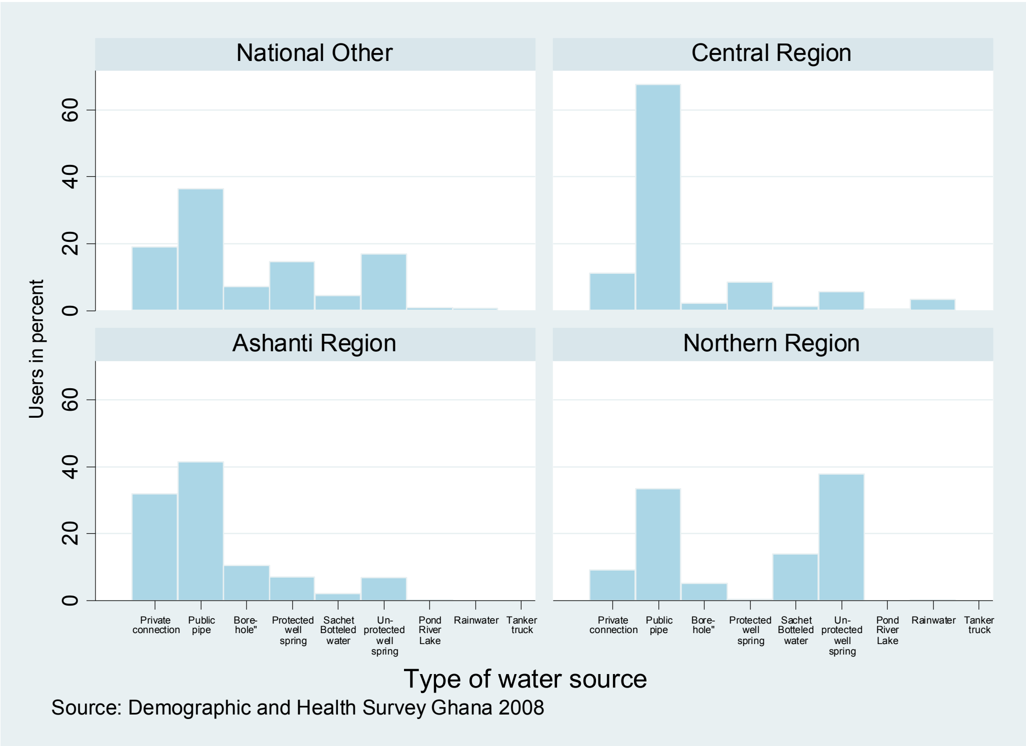
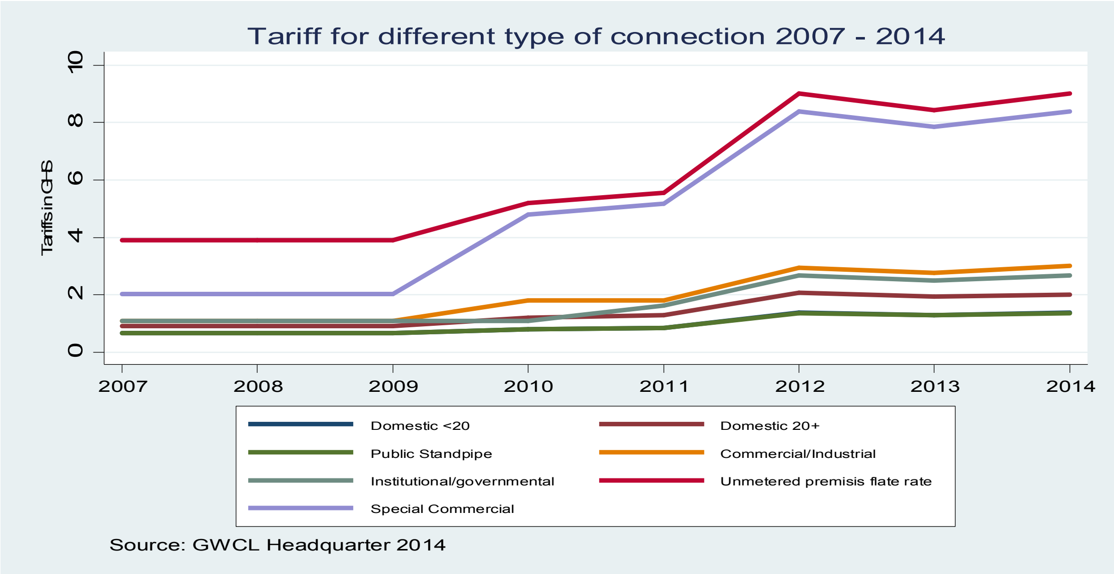


Figure 2 shows the different tariffs per m³ of piped water in urban areas of Ghana for different end-user groups. Since 2009, the Public Utilities Regulatory Commission (PURC) has adjusted the tariffs several times. The tariff for domestic private connections with less than 20m³ per month is GHS 1.38/m³ and almost equal to the tariff at the public standpipes which is GHS 1.36/m³ (blue and green line). To the best of our knowledge these tariffs are currently applied. However, especially in unmetered premises, the official tariffs are arbitrarily applied as we learned from interviews conducted for this evaluation. Several people reported to have a different flat rate tariff, varying from GHS 10 to GHS 60 per month, independent from actual consumption. We also discovered that the definition of a *public* water source is quite subjective. Some private households selling water to customers from their private connection, and having a monthly consumption above 20m³, are charged with the lower rate for public standpipes whereas some public standpipes are charged with the higher tariff for private connections with 20+ m³ consumption.

The revenues based on the tariffs only cover the cost of production, repairs and maintenance but are not sufficient to pay for the construction loans and/or new investments. According to the headquarters of GWCL, revenues are used to pay for - in a descending priority order - the electricity bill, other production inputs such as chemicals, and salaries. The remainder is used for repairs and maintenance. This gives a first impression of the serious threat to financial sustainability of the water projects: the tariffs in Ghana are too low and the tariff structure is not transparent and arbitrarily applied resulting in too little revenues and in too much non-revenue water. Especially where no meters are installed, the billed amounts for households and institutions are much lower than the amounts GWCL should have charged for their actual consumption to at least achieve full cost recovery.

Figure 2: Ghana Urban Water Tariffs



Source: GWCL documents. Note: Unmetered flat rates show the total monthly expenditure whereas all other tariffs are reported in GHS per m^3.

2.2. Sudan - Khartoum

Khartoum State operates 11 water plants in the Greater Khartoum area (see Table 1). According to KSWC, the current production of these water treatment plants is in total 776,883 m^3 per day, serving the approximately 5 million inhabitants of Sudan's capital. Al Manara water treatment plant is the second largest plant in Khartoum and provides about 24% of the total daily water production by water treatment plants. As the people also use boreholes (numbers unknown), KSWC estimates Al Manara's contribution to the total daily water production at 13%. The average per capita daily water consumption is estimated between 150 and 250 litres per capita per day and is based on water production figures and not real water consumption. Several of the water treatment plants seem to produce above their maximum production capacity, e.g. Tuti or Bahry North. It is unclear whether these figures are correct since flow meters are often missing or not working properly.

Table 1: Current Water Production in Greater Khartoum

	Station	Capacity m3/day	Monthly actual water production in m3	Daily production in m3
1	Al Mogran	90,000	2,465,370	79,528
2	Tuti	1,200	121,250	3,911
3	Burri	16,920	668,200	21,554
4	Suba	100,000	3,181,348	102,624
5	Jabal Awliya	68,000	1,400,000	45,161
6	Bait Almal	27,000	1,206,500	38,919
7	Bahry	300,000	7,134,100	230,132
8	Bahry North	50,000	1,663,000	53,645
9	Alsalha	15,000	461,350	14,882
10	Omkati	1,200	20,010	645
11	Al Manara	200,000	5,762,341	185,882
Total m³/day		**874,820**	**24,083,469**	**776,883**

Source: KSWC Water production department, 2014

According to the Sudanese Household Health Survey (data not accessible, only a final report) conducted by the Ministry of Health in 2010, 67 % of the population in urban areas use, from a quality point of view, reliable drinking water sources. However, the quality of the available data on Sudan is poor. As an illustration, UNICEF does not even publish a country fact sheet on main demographic and health indicators. The World Development Indicators of the World Bank show a deteriorating situation: 69% of the urban population had access to improved water sources in 2007 while only 66% had access in the period 2010 to 2012. The lower access rates most probably result from the strong population growth rather than from breaking down of the water provision system in Khartoum.

Concerning the tariff system in Sudan, one has to distinguish between two types of tariffs: first, the tariff Al Manara Water Company (AMWC) charges KSWC and second, the tariff KSWC levies from end-users.

AMWC Water Tariff to KSWC

AMWC operates the plant on the basis of a 'break-even' tariff, i.e. it makes no profit or loss from the project but ensures that the annual revenues are sufficient to cover the interest costs and repayment of the loans, and the costs of operating and maintaining the water treatment facilities. The resultant water tariff has two components: a 'capacity charge' and a 'consumption charge' which are both billed monthly to KSWC. The 'capacity charge' is a Euro denominated tariff that is based on the full operating capacity of the water treatment plant (200,000 m^3 per day). This charge covers repayments and interest on the loans and the fixed operating and management costs of the water treatment plant, such as fixed electricity costs, salaries, management fees, administration and maintenance costs. This part ensures that the lenders are paid and that Al Manara can operate independently of the volume of water produced. The second component, the 'consumption charge' is based on actual water consumption. This part covers the variable costs of the water volumes produced, such as variable electricity costs, chemical consumption and costs for sludge disposal.

The nominal combined tariff in the BOOT Agreement was Euro 0.2422/m^3, composed of a 'capacity charge' of Euro 0.1892/m^3 and a 'consumption charge' of Euro 0.053/m^3. In 2014, it is Euro 0.2296/m^3, split into a 'capacity charge' of Euro 0.1902/m^3 and a 'consumption charge' of Euro 0.0394/m^3. A higher capacity tariff stimulates KSWC to distribute more water as this part is based on full operating capacity.

KSWC Tariff to Consumers

The current water tariff system and pricing structure in Khartoum State is a flat rate system that charges a single fixed fee per household per month according to the classification of residential houses[5] regardless of usage. This system is applied to both residential and commercial sectors. Table 2 compares the water tariffs in 2008 and 2014, showing almost no change except for class 3 connections where the price even decreased. The tariff was designed based on estimates of KSWC for average per capita water consumption per day in the three residential classes. The tariff depends on the size of the house and the size of the connection pipeline, but not on the actual water used because meters are lacking in the distribution network and at household level.

The daily consumption figures seem to be very high and not realistic. They are based on information from KSWC reports and the project documentation of the Al Manara project. An explanation might be that people use a lot of water because of excessive hygiene such as showering twice a day and the ritual ablution (Wudu) before the five daily prayers. Other estimates of daily per capita consumption range between 27 litre/capita/day in poor residential areas (Cairncross and Kinnear 1992) to 70 litres/capita/day in richer residential areas (Edge Consultancy 2007). The figures published by KSWC as described in Table 3, are based on water production figures and not real water consumption.

[5] The three class water tariff system is based on the Khartoum town planning system, which classifies housing as first class with a size from 500 to 1200 m^2, second class with a size from 400 to 700 m^2, or third class with a size from 200 to 400 m^2 (Shora Consultancy 2006).

Table 2: Tariff System for Greater Khartoum (in SDG)

Class	Area	Tariff 2008	Tariff 2014	Average Per Capita Consumption (litres)
1	Class 1: 1 inch connection (residential)	41	45	250
2	Class 2: ¾ inch connection (residential), and offices, apartment houses, supermarkets and clinics	25	25	200
3	Class 3: ½ inch connection (residential)	19.5	15	150

Source: KSWC Sales Department, 2014

There are 154,337 private connections to Al Manara. The majority of the customers (85,534) live in the Kararie Locality and are of class 3, i.e. richer households, see Table 3. The other customers live in Omdurman with 4807 connections and the Ombadda locality with 63,998 connections. The customers in the three areas are only connected to Al Manara and not to other water treatment plants. There is no possibility to receive water from other plants except from street water vendors.

Table 3: Customers of Al Manara (including Ombadda, Omdurman and Kararie)

Customer Class	No. of Customers	Revenue / Month
Third Class	112,667	1,690,012
Second Class	38,584	964,618
First Class	3,086	138,905
Others (commercial)		206,465
Total	**154,337**	**3,000,000**

Source: KSWC 2014

According to the sales unit at KSWC, the fees collection between 2011 and 2014 has improved drastically with the introduction of a pre-paid system combining water and electricity in 2012. Water and electricity fees have to be paid at the beginning of the month at local offices of the Sudanese Company for Electricity Distribution, a governmental company under the Federal Ministry of Electricity and Water Resources. These offices are called sale centers (marakiz tawzi') and Khartoum State has approximately 34 centers. In addition to the sale centers, there exist about 3150 'sale points' and 6000 'sales points' functioning through a 'third party' such as supermarkets and kiosks in the neighbourhoods. The offices and 'sale points' are scattered all over Khartoum with easy access by the population. Customers buy their electricity and pay their water bills without waiting in long queues and the 'sales points' usually have long opening hours from morning till evening and even during holidays.

According to the qualitative interviews, the water fees vary between neighbourhoods and not by residential class or property/pipe size. Traditional neighbourhoods pay a flat rate of SDG 15 per month; modern neighbourhoods pay SDG 25 per month. The amount is charged by electricity meter and not per house, as one house can have more than one electricity meter. Today, the combination of electricity bills with water bills is the main billing system that covers the majority of the KSWC customers (residential areas). The prepaid billing system was proposed earlier in 2010 but it has only been implemented in 2011.

3. The Clients

3.1. Ghana Water Company Ltd.

The development of the water and sanitation institutions of Ghana is described in Table 4. When the Ghana Water and Sewerage Corporation (GWSC) was established in 1965, urban and rural water infrastructure was managed and organized within one institutional framework. In 1994, GWSC was divided into an urban department remaining under GWSC and a rural department, the newly founded Community Water and Sanitation Department (CWSD). Finally in 1998, the Community Water and Sanitation Agency (CWSA) was established as an independent institution for rural water and sanitation supply infrastructure. The urban department was transformed into a 100% state owned limited liability company, the Ghana Water Company Limited (GWCL).

In 1997, two new institutions were founded, the nationwide Water Resource Management Commission (WRC) and the Public Utilities Regulatory Commission (PURC) for price regulation of water and electricity. Each water infrastructure system connected to national water resources such as groundwater (e.g. boreholes) or surface water (e.g. water treatment plants) has to seek approval from the WRC before starting construction and operation, and has to pay an access fee. The responsibilities of PURC are to examine and approve water and electricity rates, protect the interests of consumers and providers of services, monitor and enforce standards, receive and investigate complaints and settle disputes between consumers and public utilities.

Table 4: History of the Ghana Water Company

1965	Ghana Water and Sewerage Corporation (GWSC) established to produce and distribute urban and rural water supply
1994	Kokrobite Conference announces the National Community Water and Sanitation Programme (NCWSP)
1994	Separation of urban and rural water supply. Community Water and Sanitation Department (CWSD) created within GWSC
1997	GWSC converted into a limited liability company, the Ghana Water Company Limited (GWCL) with responsibility for urban water supply
1997	Public Utilities Regulatory Commission (PURC—economic and price regulation) and Water Resources Commission (WRC—management of water resources) established
1998	Community Water and Sanitation Agency (CWSA) established for rural water supply systems
1999	GWSC was converted into a 100% state owned limited liability, Ghana Water Company Limited, responsible for urban water supply
2005	Private operator Aqua Vitens Rand (AVRL) selected for a five-year management contract for urban water supply, as a condition for a World Bank sector loan
2010	End of AVRL contract, management went back to GWCL completely

Source: http://www.gwcl.com.gh/pgs/history.php

Over the last 10 years several attempts have been made to privatize the water market in Ghana. As a condition of a World Bank sector investment loan of $103 million for infrastructure investments in 2005, the foreign private operator Aqua Vitens Rand Ltd. (AVRL) was given a five year management contract of the urban water supply sector (World Bank, 2004). Under the contract, started in 2006, the management and operation of water treatment plants and local operations fell under the supervision of AVRL. All staff of GWCL was transferred to AVRL with the overall aim to make the organization more efficient, especially by reducing staff at the Accra head office (overhead) and administrative personnel. The main objectives of the contract were reducing the amount of non-revenue water by increasing collection rates of water bills while improving the reliability and quality of potable water and customer services at the same time. However, almost all targets were missed which generated massive public dissatisfaction with AVRL. The management contract expired in 2010 and was not renewed. Subsequently GWCL was restructured by the government and mandated, once again, to take over the management of urban water systems in the country since 2011 (Vitens Evides Int., 2011).

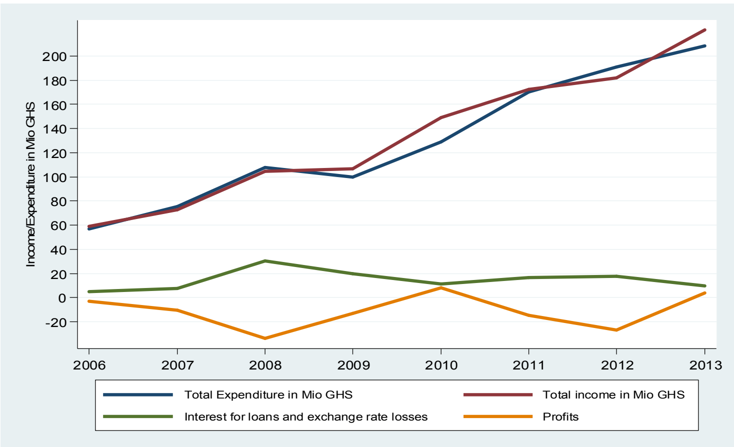
GWCL is a 100% state owned, limited liability company but investment cost of water infrastructure is financed directly by the Ministry of Finance (MoF) from the general budget. The tariff structure designed for water sales only covers the costs of operation and maintenance (staff, operation of treatment plants and distribution systems, spare parts, chemicals, etc.). While the bulk of the capital cost is funded from the general budget, additional funding is sought from donors. As a result GWCL has built up extensive experience with the ORET programme: the treatment plants of Sekondi-Takoradi, Weija, Tamale, Cape Coast, Kwanyaku and Baifikrom have been built or extended with ORET grants while the related commercial loans were guaranteed and serviced by the MoF.

The organization of GWCL is very centralized and top-down. The head office is based in Accra while regional offices manage the urban areas of the ten regions of the country. All regional offices report monthly figures of production, cost and demand for chemicals to the head office. Monthly budget mandates are allocated to the regions by the head office. The management of spare parts is also organized centrally via the main depot in Tema, east of Accra. The organization and distribution of responsibilities within GWCL is not transparent. Administrative processes are slow and bureaucratic. The hierarchy and lack of decentralized responsibilities hinder rapid responses to operational and management issues that arise.

An indicator used frequently by the World Bank to evaluate efficiency of GWCL is the number of staff per 1000 connections. Since 2006, the ratio of GWCL staff per 1000 connections decreased from 7.9 to 6.8 in 2013, however, mainly as a result of more connections.

The annual financial statements of GWCL show that it is building up a cumulative deficit over the years. It has only made a small profit in 2010 and 2013 (see Figure 3). The total deficit at the end of 2013 was GHS 331.6 Million (approx. € 80 Million). The income from water sales hardly covers total expenditure for production and operation of urban water markets. Loans could not be serviced (interest and amortization) from the revenues and price increases on imported inputs contribute significantly to the increasing deficit due to the exchange rate depreciation. However, GWCL is not responsible or able to pay back the loans for the investments as the responsibility lies with the Ministry of Water Resources and Housing and the Ministry of Finance.

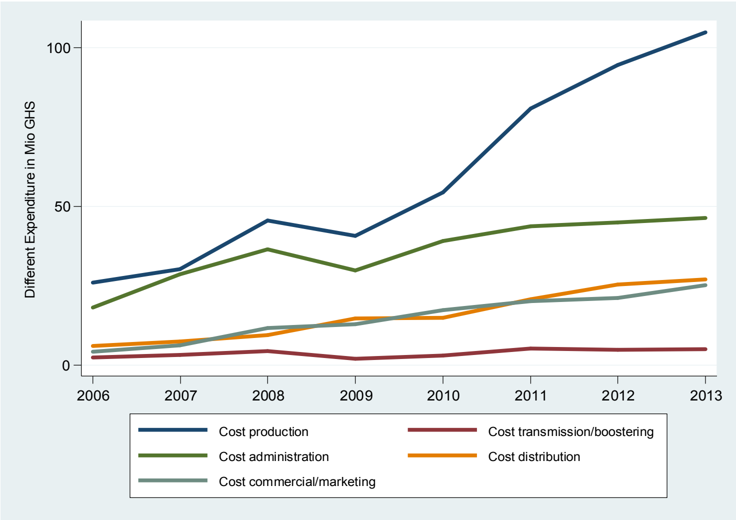
Figure 3: Balance GWCL 2006 - 2013



Source: GWCL Financial Statements 2007-2013

Since most inputs used for water production, such as chemicals and spare parts, are imported, the depreciating exchange rate is one of the main causes of the drastically rising production costs in the local currency since 2010 (see Figure 4). Other causes for these increases were the increases in prices for fuel and electricity.

Figure 4: Expenditure GWCL 2006 - 2013



Source: GWCL Financial Statements 2007-2013

3.2. Khartoum State Water Corporation

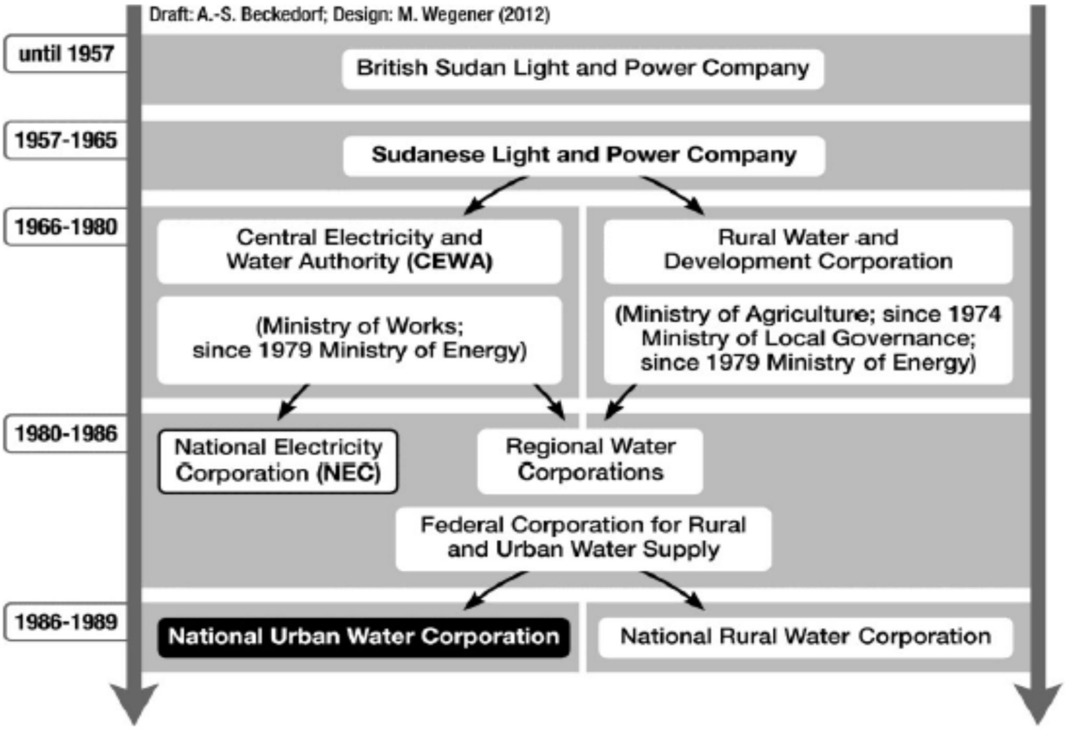
The Khartoum State Water Corporation (KSWC) was founded in 1994. It is a 100% state owned company and responsible for the provision of potable water in the capital and Khartoum State. In general it is difficult to access relevant data from KSWC. According to the profound research of Beckedorf (2012) due to "the low degree of documentation, and […] highly hierarchical structure of KSWC, most relevant information remains in the hands of a few high-ranking members of the KSWC senior management", who are not willing to share that information. Our evaluation team also had to seek permission from the Khartoum State Economics Intelligence Unit for our research. Thanks to the official letters from IOB, the Netherlands Embassy and the Khartoum State Ministry of Infrastructure and Transportation, it got access to KSWC. Thereafter we could conduct personal interviews, but did not receive much cooperation or sufficient data, especially no financial reports. All results and conclusions regarding KSWC have therefore to be interpreted with caution. In addition to the scarce public information on past and present performance of KSWC, we received limited information on sales, non-revenue water, and expenditure for operation and maintenance.

Figure 5 shows the development of the national water institutions in Sudan. After independence in 1956, the Sudanese Light and Power Company was established as a private company. After the nationalization in 1966 the Central Electricity and Water Authority (CEWA) became active for urban areas under the Ministry of Works (later Energy). In rural areas the Rural Water and Development Cooperation was responsible for water provision located under the Ministry of Agriculture (in the 1970s under the Ministry of Local Governance followed by the Ministry of Energy since 1979). Under the decentralization policies of the 1980s the responsibilities of water management were given to the nine established regions. Although a system of regional rule was introduced, the power remained in the hands of the national government and the president. During the decentralization process, the responsibilities for water and energy were separated and the authorities devolved to regional offices though still under one Federal Cooperation for Rural and Urban Water Supply. During the 1986 to 1989 period the responsibilities for urban and rural areas were separated again. Under the Water Sector Reform in 1994, the KSWC was founded and became responsible for water supply in Greater Khartoum (see Beckedorf, 2012, chapter 4 for a detailed description of the development of the water institutions).

Administratively, KSWC is managed through a Management Council which is composed of the General Manager (GM) and his deputy. The GM office is supported by a number of offices such as the Executive office, Media and Public Relation office, Monitoring office, the Internal Audit office, the Legal Administration and Localities Affairs Coordinator. KSWC is divided into several units such as Project

Planning Unit, Water Resources Unit, Technical Affairs, Laboratories and Quality Control Unit, Sales Unit, Human Resources Unit and Localities Unit.

Figure 5: History of KSWC



In total, KSWC has 2.778 employees. According to the Human Resource department of KSWC, approximately 65% are administrative staff and 35% are technical staff, which indicates the overhead within the company.

4. The Inputs of the ORET Transactions

4.1. Kwanyaku Water Treatment Plant

The Kwanyaku I (GH00028) and Kwanyaku II (GH00145) were two related projects for rebuilding and extending the existing water purification system. Activities started in 2003 and 2006 respectively. The raw water stems from the Ayensu River. Kwanyaku I built a complete new water purification plant and pumping stations, and expanded the existing distribution network in the catchment area. Kwanyaku II involved an extension of the network to Senya Bereku.

The Kasoa Interconnection Project (GH/WMO7094) or Kwanyaku III complemented the other two projects. The project involved the installation of a transmission and distribution network, and the construction of a 500 m³ water reservoir, small scale public sanitation facilities and standpipes to improve the water supply in communities in the Kwanyaku catchment area. Across various communities a total of 122 public standpipes were constructed supplying the population of the area with piped water.

The beneficiaries of the water installations are the inhabitants of the region around Kwanyaku: about 50,000 individuals should gain access to potable drinking water as a result of this project. Below special attention will be given to access for the poorest inhabitants, as this group often depends on public water infrastructure such as standpipes, borehole hand-pumps and sometimes traditional water sources (wells and ponds) that are free of charge.

The target of the project was to expand the capacity of the old water treatment plant from 14,000 m³ per day in 2003 to 35,000 m³ per day, improving the water supply situation in the Kwanyaku catchment area. The transaction concerned the rehabilitation of the current purification installation (14,000 m³ per day) and the construction of a new installation (21,000 m³ per day). It also included dredging the Ayensu River, constructing a 2500 m³ water tower at Swedru and improving the distribution network with the installation of new 300 mm transmission pipes from Kwanyaku to Swedru. Five sub-networks are supplied with the water from the new (NWTP) and old water treatment plant (OWTP) and the distribution systems:

- Swedru (NWTP)
- Nyakrom (NWTP)
- Obachere (NWTP)
- Senya Beraku/Ojobi (OWTP)
- Pinanko (OWTP)

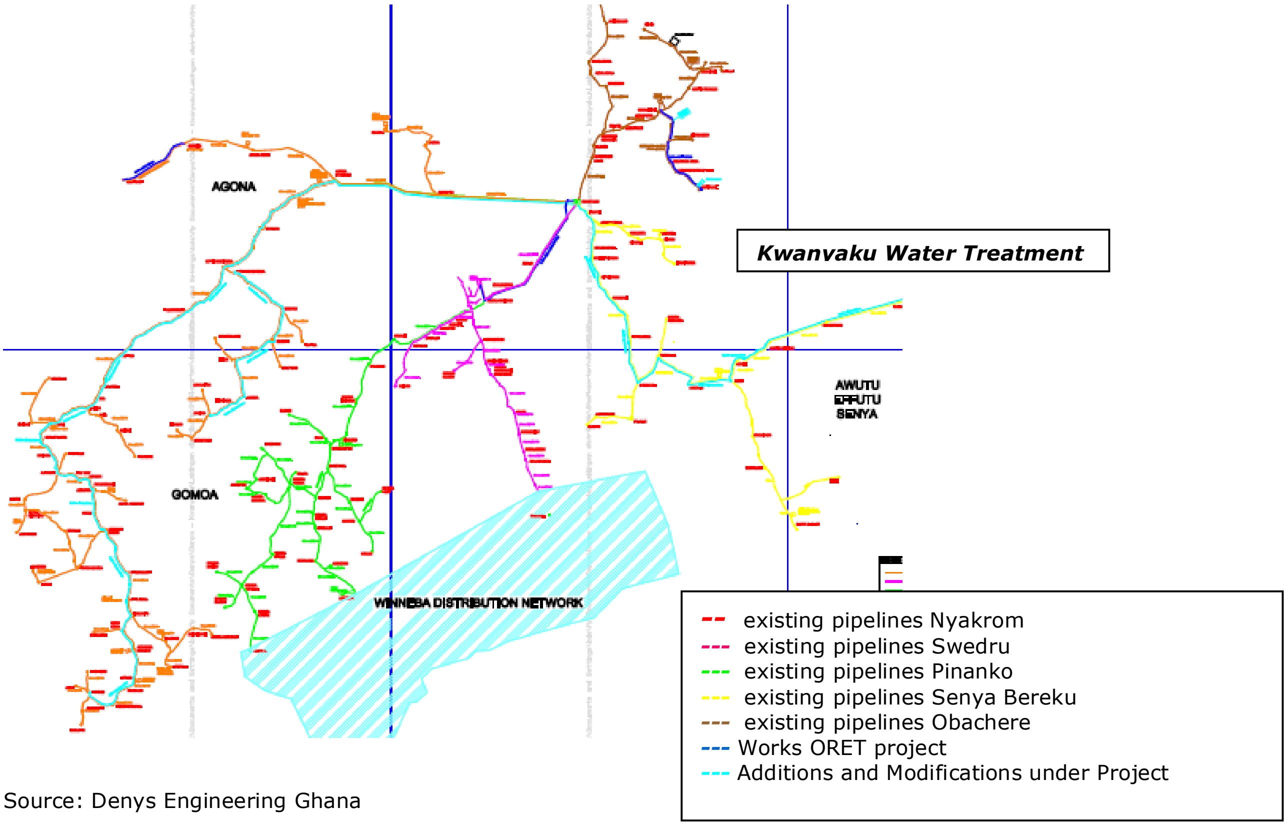
The map in Figure 6 shows the Kwanyaku region and the catchment area of the distribution system of the plant. The region covers mainly semi-urban areas and urban areas. Along the coast several hotel resorts purchase water from the Kwanyaku treatment plant.

4.2. Tamale Water Treatment Plant

The Tamale water project (GH00124) aimed to rehabilitate the existing water plant (20,000m³/day) and construct a new one with a 25,000m³ daily production capacity. Raw water is extracted from the White Volta River, treated at the plant and then piped to Tamale through a 25 km distribution pipeline. In addition, a new reservoir, a new transmission station and distribution pipelines were constructed.

The beneficiaries of the water installation are the inhabitants of Tamale and the region around the capital of Northern Region, estimated at approximately 400,000 people (Ghana Census 2010). All individuals in the Tamale metropolitan area should gain better access through an increasing number of household connections and a higher supply rate. No end-user level intervention, for example standpipe construction, has taken place here.

Figure 6: Map of the Kwanaku Catchment Area



Source: Denys Engineering Ghana

The construction included the installation of new raw water intake pumps and a 6.9 km ductile iron raw water transmission pipeline from the river to the plant. The new water treatment plant was constructed next to the existing plant. From the plant to town, a new 22 km ductile iron treated water transmission pipeline was constructed parallel to the existing transmission pipeline. The new pipeline delivers water directly to town without distributing water to the villages along the pipeline. This caused extreme water pressure losses in the old transmission pipe because large amounts of water were drawn from the pipes before the water reached Tamale. The existing 450 mm transmission pipeline supplying the corridor villages was rehabilitated and water meters were installed as part of the Technical and Maintenance Assistance (TMA). TMA was focused on technical and institutional strengthening of employees of the plant and the regional office of GWCL.

4.3. Barakese Water Treatment Plant

The Barakese project (GH00137) rehabilitated the existing Barakese water treatment plant that together with the Owabi water treatment plant supplies Kumasi, the capital of the Ashanti Region. At Barakese, two new production modules were constructed with a production capacity of 27,300 m^3 per day each. The raw water stems from the large perennial Ofin River which flows into the Barakese reservoir. The much smaller stream (but still perennial) Owabi River flows into the Owabi reservoir. Both reservoirs and dams were built in the 1960s.

The beneficiaries of the Barakese water installation are the inhabitants in and around Kumasi with an estimated population of 2.1 million people (Ghana Census 2010). As a result of this project all individuals in the Kumasi metropolitan area should gain better coverage, a higher supply rate and additional access to potable drinking water.

The installations involved a modification and expansion of the production system by rehabilitating and extending the raw water high lift pumping units to get more raw water into the plant's system. Two additional modules (flow division chambers, clarifiers, filters, etc.) were installed in addition to the existing three production modules. The original contract given to Taylor Woodrow included only one new module, but a second one was added when the revision of the transaction was approved in 2010. A new booster station with a 2500 m³ reservoir on the transmission line and a new reservoir in Suame were installed to guarantee better water supply in times of power cuts and break downs. The existing distribution system, mainly the transmission mains between the water treatment plant and sub-networks, was rehabilitated and extended. To monitor the system, 60 zonal meters were installed.

4.4. Al Manara Water Treatment Plant

The Omdurman Water Supply Project implied the construction of a completely new drinking water treatment plant in Khartoum, with a capacity of 200,000 m³ per day, transmission mains, a connection to the new storage reservoir (40,000 m³) and booster station at Al Thoura, and the connection to the existing storage in Al Gamayir. In addition, a Water Asset Management Programme (WAM) was put in place with a view to reduce the volume of unaccounted for water and improve the distribution management, operation and maintenance. The ORET support was in particular focused on the Al Manara water treatment plant and the WAM. The other components of the project, such as Thoura Reservoir, the transmission mains and the sludge treatment from the plant and everything else not associated with the water treatment plant, were executed under a different contract. The operation and maintenance of the treatment plant remains under control of AMWC for 10 years until the loans for the construction cost have been repaid. The final date for repayment is foreseen in 2020 after which the shares in Al Manara held by Biwater and FMO are transferred to KWSC.

A crucial component of the Al Manara project was the WAM. This involved technical training of staff of Al Manara and KSWC to guarantee administrative success. The WAM-training was conducted by Biwater and Farrer Consultancy. During the training it became clear that effective management of the water system would require essential information on the pipe network, maps of pipes and flow meters, all of which were missing. So part of the funds for WAM went into developing a monitoring system of the piped network, digitalizing and visualizing information into cartographic material. According to Biwater managers, this training has not gone far enough because available funds were not sufficient to build up KSWC as an institution.

The production of clean drinking water from the Nile River is a challenge in itself, as the raw water contains a lot of solid material (clay), requiring special (imported) filters for the treatment plant. The implementation of the construction was successful in technical terms, despite some delays in the work because some construction materials were stuck in customs.

The interesting aspect of the project for KSWC was the BOOT (Build, Own, Operate, Train/Transfer) agreement and the capital-light funding structure (see below). With this arrangement, KSWC does not have to finance the high cost of the construction up front, because it is financed through a mix of a grant and loans. After construction the plant is operated by the international company Biwater. The debt service (interest and amortization) of the loan is funded from the 'capacity charge' that KSWC pays for the produced water based on the full operating capacity of the water treatment plant (200,000 m^3 per day), and not by any government institution. KWSC remains responsible for installing the household connections, running the distribution network and billing its customers. The basic idea is that in the end, the payments of newly connected end-users pay back the investment in the water treatment plant, provided of course that the consumed water is properly invoiced and collected.

5. Financing of the Transactions

5.1. Ghana

The total ORET grant of the three Kwanyaku related water transactions amounted to € 16,862,410 on a total transaction value of € 40,497,167 (see **Error! Reference source not found.**). The largest grant amount was allocated to Kwanyaku I. With 35%, the share of the ORET grant was lowest for this transaction. Reason being that the application predated the introduction of the 'Water Facility' within ORET in 2005 which allowed a maximum grant share of 50% for water projects also in non-least developed countries. The weighed grant share of all Kwanyaku transactions was 42% whereas the grant shares of Tamale and Barakese were 53%.

In the case of Tamale, the non-grant funding, being € 21 million and 47% of the transaction amount, was financed by a commercial export credit from ING Bank N.V. which was insured by Atradius Dutch State Business N.V. (see **Error! Reference source not found.**). ORET was nevertheless attractive for Ghana to co-finance its investments in the drinking water sector because of the size of the available and required funding and the higher grant element of ORET, especially after the introduction of the Water Facility within ORET in 2005.

The commercial loans connected to the ORET grants came, however, at a relatively high price if one considers the total one-off cost of the non-grant funding in terms of bank fees and especially the credit insurance premium. These one-off finance costs were compensated for 75%from the grant. This did not include the regular debt servicing of the commercial loans in terms of the interest (usually Euribor plus a margin) and the amortisation of the loan.

The one-off financing cost varied from 15.0% to 24.9% of the non-grant funds and for all five water transactions the weighted average was 18.9%. In the case of the Kwanyaku transaction GH00028, part of the export credits that financed content of less than 50% Dutch origin, was insured with the Belgian state insurance agency Delcredère for an premium amount of € 749,000, because the applic Even when the risks in underlying transactions are more or less the same, we still find a considerable variance in these one-off cost that cannot be easily explained. There are hardly any differences, because the sector, the end user and the recipient country are the same and the periods in which the loans and the insurance policies were acquired, largely overlap. In all five water transactions, the non-grant finance consisted of insured long-term (10 year) export credits provided by Dutch banks. However, the one-off total finance cost of these transactions still ranged from 15.0% for Kwanyaku II to 24.9% for Kwanyaku I of the commercial loans. The bulk of those cost (75–95%) arose from the insurance premiums for the credit risk and the manufacturing risk. Table 5 shows that the premiums for the credit risk were the highest among the one-off finance cost and varied from a share of 10.9% of the non-grant funds for Kwanyaku II to a share of 17.5% for Kwanyaku I.

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Table 5: Financing Structure and One-off Finance Costs of the Drinking Water Transactions in Ghana

Title/ ORET Code	Company/ Dutch Bank	Definitive Grant/ Grant Share	Transaction Amount/ Non-Grant funds	Risk Premiums[1]/ Credit Risk Premium Atradius	% of Transaction Amount/ % of Non-Grant	Administrative Cost Atradius
Kwanyaku I GH00028	Denys ABN	€ 8,447,000 35%	€ 24,136,000 € 15,688,400	€ 291,331 € 1,991,682	1.2% 12.7%	€ 3,000 € 1,500
Kwanyaku II GH000145	Denys ABN	€ 2,086,637 51%	€ 4,131,000 € 1,978,690	€ 28,122 € 216,069	0.7% 10.9%	€ 3,000 € 1,500
Kasoa GH/WM07094	Denys ING	€ 6,328,773 52%	€ 12,230,167 € 5,879,834	€ 114,947 € 721,604	0.9% 12.3%	€ 3,000 € 1,500
Barakese GH000137	Ballast ABN	€ 19,733,090 53%	€ 37,426,767 € 17,619,282	€ 332,382 € 2,192,124	0.9% 12.4%	€ 3,000 € 1,500
Tamale GH000124	Biwater ING	€ 23,750,000 53%	€ 44,943,934 € 21,193,934	€ 442,904 € 2,601,031	1.0% 12.3%	€ 3,000 € 1,500

Company/ Dutch Bank	Country/ Client/ Risk Class[2]	Guaranty Premiums[3]	Drawing Period[4]/ Credit Period[5] (Months)	Other Credit Insurance Costs[6] (% non-grant)	Total Insurance Premiums/ Bank Fees	Total One-off Finance Cost[7]/ % of Non-Grant Finance
Denys ABN	Ghana/ GWCL/ 6	€ 70,116	29 120	Delcredere € 749,000 (4.8%)	€ 3,106,629 € 792,041	€ 3,898,670 24.9%
Denys ABN	Ghana/ GWCL/ 6		3 120		€ 248,691 € 48,358	€ 297,049 15.0%
Denys ING	Ghana/ GWCL/ 6	€ 21,362	20 120		€ 862,413 € 327,097	€ 1,189,510 20.2%
Ballast ABN	Ghana/ GWCL/ 6		24 120		€ 2,529,006 € 223,994	€ 2,753,000 15.6%
Biwater ING	Ghana/ GWCL/ 6	€ 253,599	24 120		€ 3,468,458 € 193,000	€ 3,661,458 17.2%

[1]The risk premiums (first amount in column 5) covers the premium for the manufacturering or construction policy (usually determined over the total transaction amount and the period required to complete the works) and the credit risk premium charged to the exporter for the risk that the ORET-grant would not be disbursed.
[2]The country risk classification of a recipient country is determined by the OECD Consensus and regularly updated to take account of developments. The classification of countries can vary from class 1 to 7 and is an important factor for the calculation of the minimum risk premium for the sovereign credit risk.
[3]The guaranty premiums charged by Atradius cover the risks of incorrect calling by the recipient of guarantees provided by the exporter such as the downpayment to guarantee implemention and the financial guarantee for the maintenance of the works, and risk of correct or incorrect calling of guarantees of the financing bank.
[4] The drawing period is defined as the period over which the grant and the loan are drawn down to finance the works or the transaction.
[5]The credit period is the period for repayment of the loan where amortisation usually is done bi-annually.
[6]The credit risk premium charged by the Belgian credit risk insurance company Delcredere over the components with less than 50% Dutch content. This is added to the total credit risk cost for Kwanyaku I arriving at 17.5% (12.7 + 4.8) of the non-grant funds.
[7]The total one-off finance costs consist of the sum of the total insurance costs (credit risk premiums, other risk premiums and administrative cost) and the bank fees.

5.2. Sudan

The funding structure of the Omdurman Water Supply Project is an innovative capital-light financing format. The project won three awards in 2008, 2009 and 2011 (Trade Finance Deal of the year 2008, Global Water Sustainability Award and Best international Project at the Consulting Engineers of South Africa). For the ownership, Khartoum State Water Company, FMO, and the contracted company Biwater established a special purpose vehicle company in a Public Private Partnership (PPP): the Al Manara Water Company (AMWC), see Figure 7. Funding for the project was secured through a combination of € 62 million 'soft' loans from government backed development banking institutions in the Netherlands (FMO), South Africa (IDC) and Malaysia (Mexim), together with a € 24 million grant from ORET, totalling approximately € 87 million. The project was structured as a private public partnership between the Khartoum State Government, the project lenders and Biwater BV, using a BOOT (Build, Own, Operate, and Transfer) type contract model.

The loan portion of the finance was provided to cover a period of 13 years, comprising an initial 3 years construction period, followed by a 10 year operating period. During the operation period, the plant is operated and maintained by the Public Private Partnership AMWC and the treated water produced, is sold to the Khartoum State Government at a rate sufficient to repay the project loans and cover the operating, maintenance and management costs of the project.

The project was divided into two components under two engineering, procurement and construction (EPC) contracts because of the ORET ceiling for individual transactions of € 45 million. The first component was financed by an ORET grant of € 24 million supplemented by a subordinated loan from the Investment Fund for least developed countries (IDF) managed by FMO. The remainder of the funds came from soft loans from IDC and Mexim. The ORET implementing agency FMO allowed that the ORET funded transaction could be part of a larger project (so the overall project amount could be larger than the ORET ceiling). Somewhat artificially, in this case the ORET grant was only allowed to be used in connection with the construction of the water treatment plant and Water Asset Management (WAM) element of the project. The water treatment plant and WAM part of the project was therefore considered as a separate EPC. The other components of the project, as Thoura Reservoir, the transmission mains and the sludge treatment from the plant and everything else not associated with the water treatment plant-EPC contract was contained in the second EPC contract.

Table 6: Funding Structure Omdurman Water Supply Project

ORET grant	€ 24,311,153
FMO/IDF subordinated loan	€ 19,976,272
Total ORET transaction	€ 44,287,425
Pure Bank Loans from IDC/South Africa and Mexim/Malaysia	€ 43,947,582
Total Omdurman Water Supply Project	€ 88,235,007

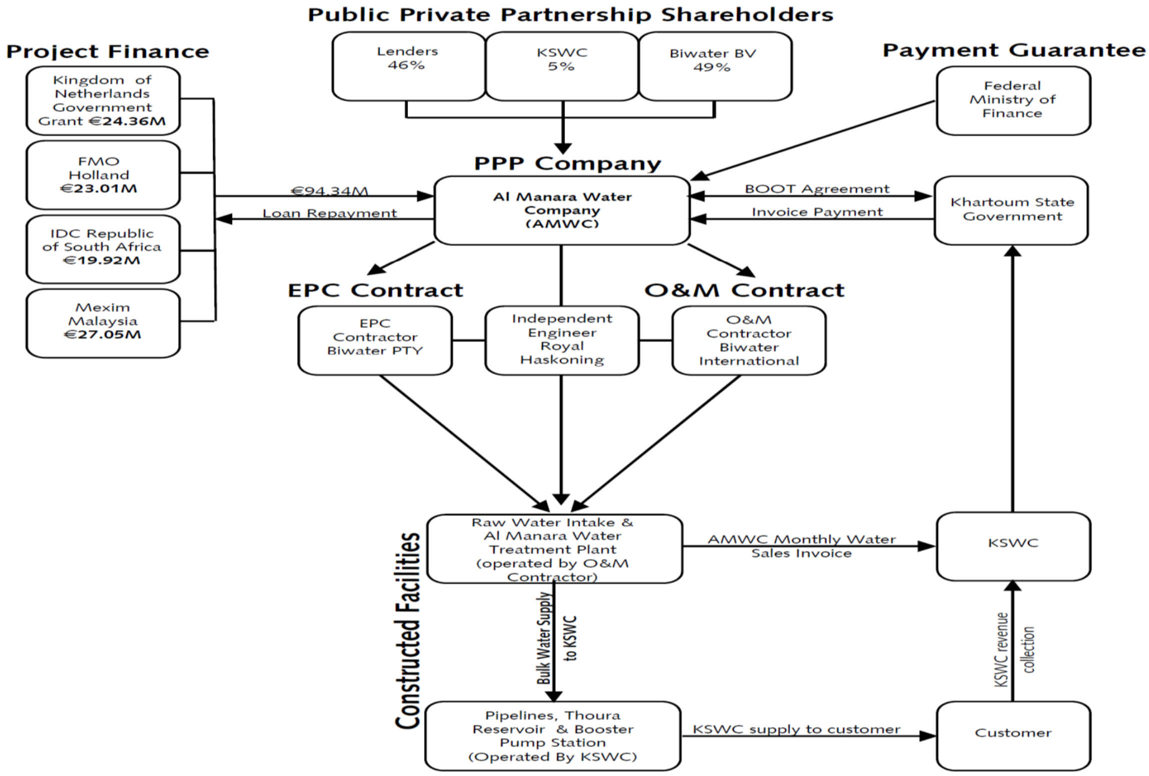
The ORET grant was not split between two contracts but was solely used for the water treatment plant and the WAM.

Year subsidy	Project number	Project title	Contractor	Transaction amount	Grant amount	Definitive grant	Grant share of transaction
2005	SD00003	Omdurman Water Supply	Biwater Contracting Pty Ltd	€44,287.425	€24,358.084	€24,311.153	55%

Source: Oret.nl documents

The idea of the BOOT contract was that the costs of construction of the water treatment plant and its operation are – indirectly - paid by the new end-users through the water bill and not by KSWC or the government. After the three-year construction period, AMWC operates the plant, i.e. the constructed facilities for a period of ten years and sells water to KSWC. These sales cover the running costs but also the repayment of the bank loans as part of the capacity charge. KSWC sells the water to the households newly connected to the water network. The BOOT contract enables KSWC to extend the water infrastructure without making huge capital investments ('capital-light'). Thus, neither KSWC, the nor Khartoum State Government nor the Federal Sudanese Government, are supposed to pay anything until the BOOT contract ends, although the Federal Ministry of Finance issued a payment guarantee. The transfer of the management of the water treatment plant to KSWC is foreseen in 2020 in accordance with the repayment scheme. However, as will be discussed below, KSWC acted too slow in expanding the network, did not adjust the water tariffs, did not install enough water meters and did not always pay the bill for the water produced to AMWC in time.

Figure 7: Al Manara Ownership and Management Structure



Source: Source Al Manara Report May 2014

6. Evaluation Methodology

6.1. Theory of Change

For analysing the outcomes and the impact of a new or rehabilitated water treatment plant and network extensions in their various dimensions, it is first of all essential to establish a Theory of Change. For analysing the outcomes and impact of the water interventions within the ORET programme, an institutional and a beneficiary (water vendors, households) analysis has been conducted for the Kwanyaku and Al Manara water treatment plants. The focus of the analysis of the Barakese and Tamale transactions was on the institutional aspects. See Figure 8 for a graphical description of the Results Chain.

Figure 8: Results Chain of Water Supply Projects

Inputs	Activities (What the program does)	Outputs (Goods & Services)	Outcomes	Long-term Results
Financial: ORET grant Commercial loans	Construct Drinking Water Treatment Plant	Increased production capacity	Affordable, clean drinking water for people living in the region	Improved water quality and coverage, clean drinking water at point if sale
Technical: Design and construction with support of construction companies (DENYS, Biwater, Ballast Nedam)	Rehabilitation of existing water purification plant	New water treatment plant rehabilitated facilities	Improve water quality and increase quantity, decrease water outages	Improved living standards: -Time savings for women - Health improvement -Income and employment opportunities
Technical consulting: Royal Haskoning	Construction/extension/ rehabilitation of piped distributions system and water reservoirs	Expanded and rehabilitated piped network, increased storage capacity	Enhanced catchment area, improve access	Additional employment of local people, Business opportunities: clean drinking water as requirement for resorts, other businesses
	Providing technical assistance (TA) and capacity training	TA and capacity training provided concerning operation and maintenance of plant	Improved technical understanding, operation and maintenance, customer relations, reduce NRW	Environmental: more efficient water production and less environmental stress

6.2. Evaluation Criteria

The evaluation of the water projects was conducted according to the six DAC evaluation criteria: Efficiency, Effectiveness, Sustainability, Relevance, Additionality and Coherence.

Efficiency

Efficiency measures how inputs and the way they were used convert into direct results. Therefore this criterion shows the input-output relationship in quantity and quality.

Efficiency was deduced from existing documents of ORET.nl and the implementing agencies in the projects (e.g. Water treatment plants, national water authorities GWCL and KSWC, constructing companies) and interviews with stakeholders to gather information on realized outputs (water treatment plants and pipelines), budget, delays and their causes.

For evaluating the technical aspects under the efficiency criterion of the installed/rehabilitated water treatment plants the following indicators are used, if made available, concerning the functioning of the plant and the distribution systems. These indicators are also important to analyse the technical sustainability of the project.

- Past/current production capacity of the plant
- How users are served?
- Number of households connected/ individuals served
- Number of hours that water is available to households
- Amount of m^3 of water sold
- Amount unaccounted-for water
- Technical indicators: km of pipes constructed, water pressure, water quality before water enters and after water leaves the piped system (end-user level standpipes and households)

Effectiveness

Effectiveness relates the direct results of an intervention (output) to the sustainable achievement of policy objectives (outcome). An intervention is considered effective if the outputs have made a contribution to the intervention's intended objectives. Efficiency and effectiveness refer to two successive levels in the results chain.

Effectiveness is deduced from the in-depths interviews of stakeholders (see Annex A1a and A1b) and in addition from the in-depths case studies from the beneficiary surveys. The focus of the surveys was on the water selling process, water quality, consumer satisfaction with the water situation and current problems (see Annex A4 and A5 for the questionnaires).

The institutional analysis is based on in-depth interviews and focus group discussions with stakeholders (managers of national water authorities and water treatment plants, local structures responsible for organizing the water vending and executing agents and end-users). The fundaments of the discussions were semi-structured questionnaires covering information on technical, financial and administrative aspects of the water market. Answers to these questions shed light on whether the water plant in itself and the distribution of water are properly working. Especially the vending process is an interesting aspect, because collecting payments and generating profits are of importance to local water authorities to guarantee the operation and maintenance of the improved water production capacity and the network. The survey in Kwanyaku catchment area focused on the vending aspect by surveying private and public water vendors at standpipes.

Additional to the institutional and technical evaluation, a special focus was put on the water quality aspect at water treatment plant level and within the constructed water distribution network. We evaluated whether water quality control systems are active and water is analysed regularly. Water quality was investigated as a health related indicator at the water treatment plant and the standpipes/households. In the case of Kwanyaku the analysis of the water quality was concentrated on the public points of sale at the standpipes because the ORET transactions did not contain interventions at the household level. There is empirical evidence that water gets re-contaminated during transport and storage when households use a public water source (Wright et al., IOB 2010). As contamination of water is likely to happen during transport between the source and the house and during storage in the house, future drinking water projects should take this dimension into account.

The survey in Kwanyaku also analysed the water quality at the standpipes. The study analysed whether the distribution system in the four sub-districts currently provides clean water at public standpipes or whether there is any contamination of the water in the pipe system. Contamination of water can happen due to frequent water intermissions in the water flow causing stagnant water in the pipes to become a medium for bacteria and pathogens growth. This phenomenon was until now mainly analysed for private household connections but we want to certify if contamination of pipes also happens in a public water distribution network.

In the case of Al Manara the survey was carried out among households in the catchment area. The focus of the survey was on the socio-economic impact of the Al Manara water treatment plant on the population. The questionnaire covered demographic data, household economic data and information on water supply, quality, customer satisfaction, use, consumption levels, costs and problems. In contrast to Ghana, in Sudan, part of the BOOT agreement of the partnership between Al Manara and KSWC was the extension of the distribution network by KWSC. Therefore, household level outcomes were part of the evaluation of Al Manara. Due to time and capacity constraints we took water samples of 160 households (total number interviewed was 924).

Sustainability

The concept of sustainability comprises seven dimensions that are relevant for evaluating an intervention: Involvement of recipient; financial and technological capacity of the recipient; environmental effects; social and cultural factors affected by the intervention (or affecting the intervention); financial and economic aspects; natural, political, economic and socio-cultural circumstances.

Assessing sustainability of the projects has been given the greatest emphasis throughout this evaluation. The indicators used to assess sustainability are multi-dimensional: financially, institutionally, ecologically, technically and socially (FIETS) sustainable. Financial sustainability is analysed in relation to the sales of the national authorities (GWCL and KSWC) and the water tariff system. Institutional sustainability is explored by disentangling the operational process. Ecological aspects are covered in the analysis of water quality and management during the production process and in the distribution system. Technical sustainability was investigated during visits of the water treatment plants and discussions with the construction companies. Social sustainability was derived by qualitative interviews with stakeholders in the water sector and end-users.

Relevance

The OECD/DAC defines relevance as a criterion indicating whether the objective of an intervention is consistent with beneficiaries' requirements, country needs, global priorities, partners' and donors' policies. Relevance additionally should demonstrate whether the intervention made a sustainable contribution in achieving the ultimate objective (the impact). An intervention has been regarded as valuable, or relevant, if it has generated effects that contribute to the ultimate development objective.

The contribution of different stakeholders to the success of the project and the ultimate development objective has been evaluated throughout the study. This will be done by investigating communication processes and cooperation of the implementing and operating institutions to assess whether the intervention has been valuable to the extent of contributing to overall increasing water supply and coverage.

Additionality

Considering additionality, we will try to establish what would have happened if the ORET transaction would not have taken place, i.e. in the absence of ORET funding. In addition, the catalytic role of ORET in mobilizing additional finance for social and economic infrastructure investments in recipient countries will be investigated.

Additionality has been researched in an institutional analysis during in-depths interviews by designing a fictitious counterfactual situation of having no additional provision of water by new and rehabilitated water treatment plant.

Coherence

Considering coherence we will assess to what extent the ORET-programme and -transactions have complemented or contradicted other instruments of Dutch development cooperation and foreign (economic) policy.

Under this criterion we will report to what extent the projects have been consistent with national policies of the recipient country and international policies of The Netherlands.

6.3 Information Sources for the Evaluation

Qualitative Methods

The evaluations were based on the following sources of information: desk research, including study of the ORET archives and additional reports provided by the stakeholders involved in the projects, semi-structured interviews with institutions, focus group discussions with staff groups and interviews of water vendors and end-users of water. The qualitative interviews were conducted during field visits to Ghana and Sudan by the Research Team (see A1a). Annex A1b and A1c list the persons and organizations interviewed in Ghana and Sudan respectively.

Annex A2 includes the semi-structured questionnaires for the different interview partners. The list of questions was adjusted and extended during the in-depths interviews and interviews were deepened in case the interviewee reported aspects important for this evaluation. Annex A3 lists the data requested from the local and national water authorities in Ghana and Sudan.

Quantitative Methods - The Counterfactual

In addition to the approach described above, a survey was conducted among beneficiaries in the respective catchment areas of the three interrelated Kwanyaku transactions and of the Al Manara Water Supply Project in Sudan. For these two case studies there are different counterfactuals. The Sudanese approach is a before-and-after method with a control group added for the 2014 survey. It intends to detect the impact by tracking changes in outcomes for programme participants over time (Khandker et al. 2010). The outcome of the treatment group $(Y| P = 1)$ is the post-intervention outcome, where the counterfactual $(Y| P = 0)$ is estimated using the pre-intervention situation. This assumes that the outcomes would have stayed the same over time if the programme had not taken place (Gertler et al. 2011). However, there are several factors that can affect outcomes besides programme treatment. These external factors cannot be differentiated from the programme effects. According to Khandker et al. (2010) the true impact of the programme can therefore not be estimated.

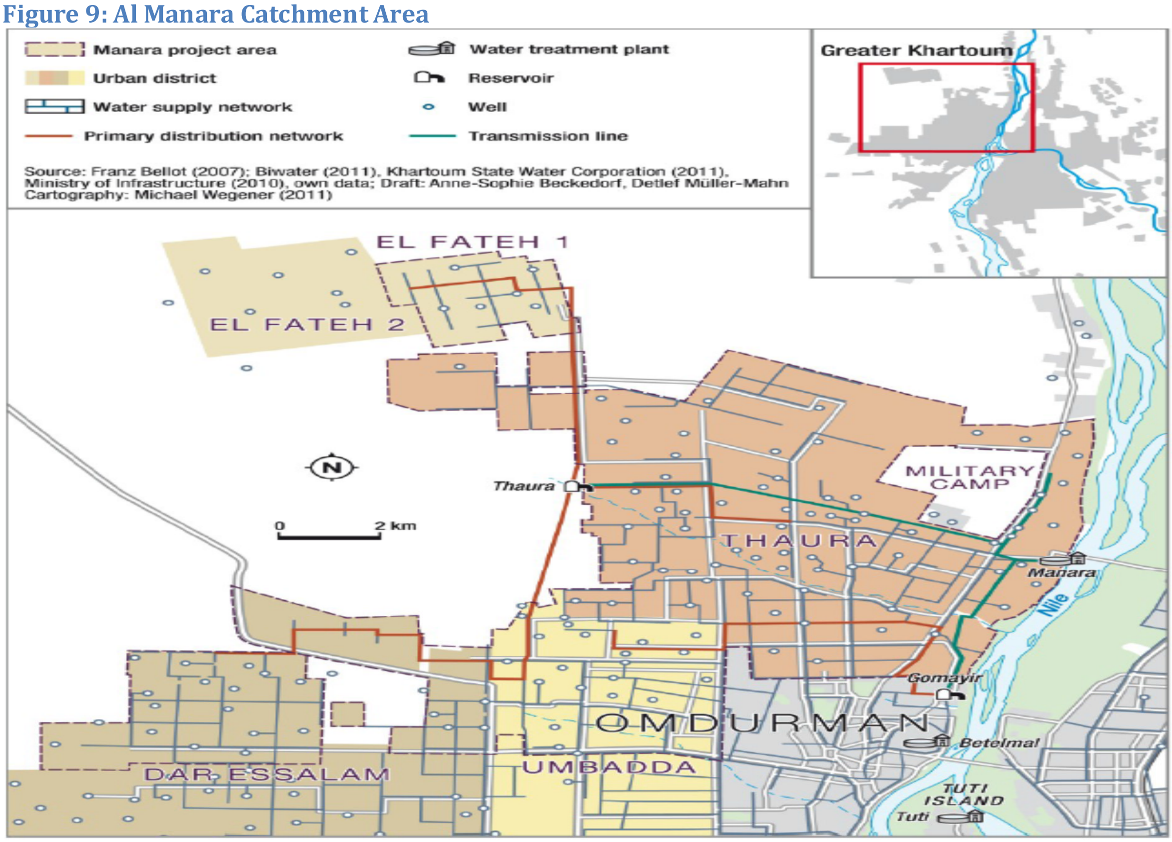
Although the before-and-after approach has its limitations regarding impact measurement, there are some situations where this approach is sufficient to establish impact (OECD DAC 2014). For example, it can be useful if a control group is missing or cannot be determined and if comparisons with control groups would be ethically questionable. In the case of Sudan, a baseline survey has been conducted but only among beneficiaries of the Al Manara water treatment plant constructed with the ORET funds. However, since we are also interested in the effect of the water treatment plant between beneficiaries and non-beneficiaries, we also sampled an extra population in an area where households are not connected to the piped system in 2014 and where water vendors act as source of water supply.

The household survey in Khartoum was conducted in the catchment area of the water treatment plant in August 2014. In total 924 households were interviewed in the Kararie Locality (Mahaliyya)[6]

[6] Mahaliyya (Locality) is the second level of the formal local governance system of Khartoum State under the *wilaya* (state)/ sub-national level. There are seven localities in Khartoum State: Khartoum and Jebel Awlia in

presented in Figure 9. The selection of areas for the study was based on a "baseline" survey conducted by the consultancy EDGE in 2007. Unfortunately, it was not possible to access the same households again, because data on identification of individual households or persons approached during the field work in 2007 was not available. This "2007 baseline" survey did not have a control group. It mainly interviewed households which already had a piped connection. In that year 80% of households were already connected to the network. The 2014 survey was conducted among 800 households in the 2007 region but in addition 124 households in Al Fateh were interviewed to investigate the current situation among the not connected households. The questionnaire covered demographic data, household economic data and information on water supply, quality, use, consumption levels, costs and problems related to water (see Annex A5). The household questionnaire was tested in a pilot study end of July 2014 and questions were adjusted according to these preliminary findings.

Figure 9: Al Manara Catchment Area



Source: Beckedorf, 2012

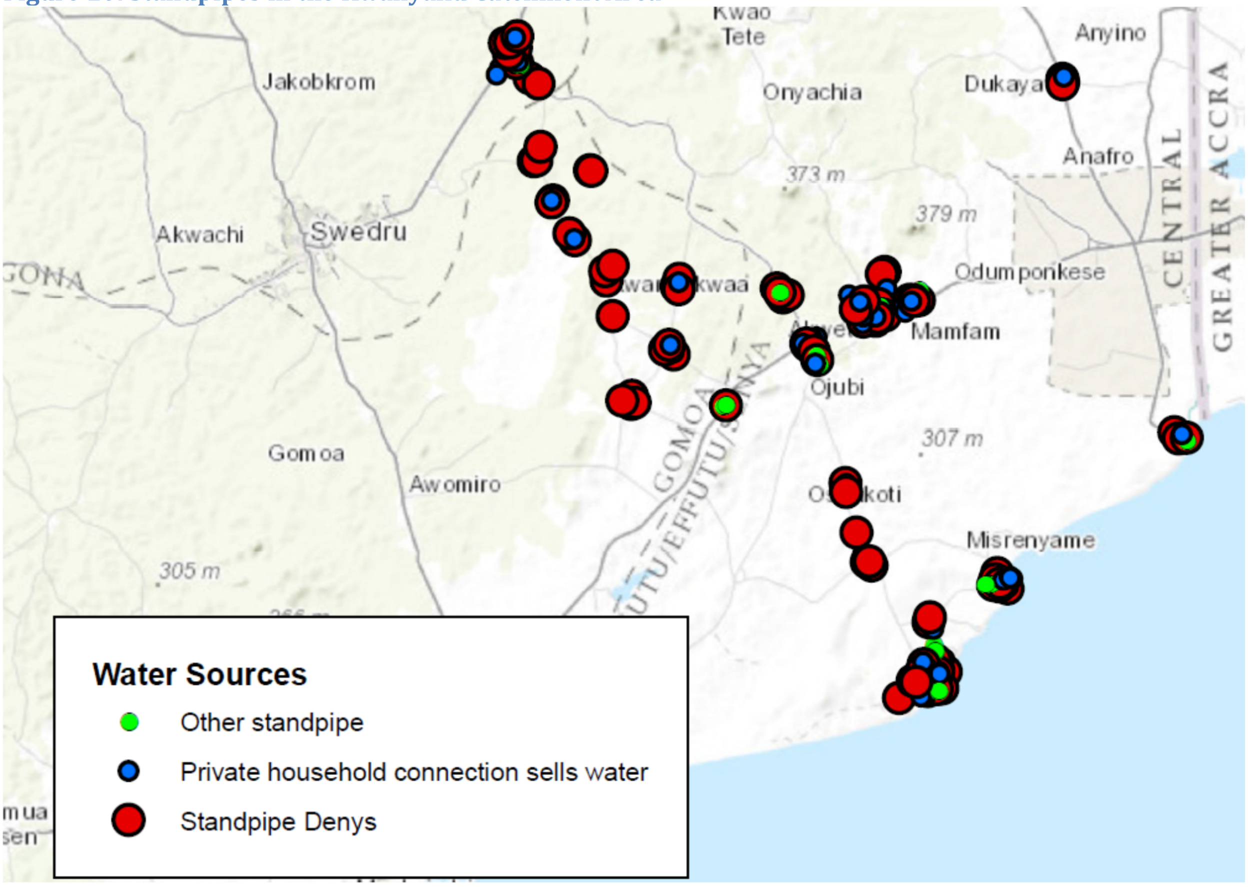
During the field work some adjustments were made based on realities on the ground. The most important deviations from the initial sampling list were that the industrial area (Al Hara 16) was excluded from the survey as it is no residential area any more. Additional to the interviews, water samples were taken from 161 households on four water quality indicators Turbidity, Residual Chlorine and E. coli (Faecal and Total Coliform).

In the case of Ghana a baseline study was not available. Based on the qualitative work a survey was designed to investigate the situation of water vending at the standpipes constructed in the Kwanyaku water treatment plant project area. The project focus was after all on the installation of a water treatment plant, a distribution network and standpipes; household level interventions were not part of

Khartoum City, Sharq El-Nil and Bahri in Khartoum North City, Umbadda and Kararie in Omdurman (see Pantuliano et al. 2011).

the project. To compare these standpipes to the other water infrastructure available to the population, in a first step a "census", or a full listing of public water sources available to the population, was made. This census among water vendors was conducted in the project area in July 2014. In total 336 water sources available to the public were detected in 35 small towns / villages. Most water sources are privately owned and operated, while the standpipes of the ORET-supported project have a mixed public/private operational system of management by (public) water committees and private operators.

Figure 10: Standpipes in the Kwanyaku Catchment Area



Using the available water source census data as sample frame, we randomly selected 156 standpipes (see Figure 10) with a share of 47% for the ORET-project standpipes and 53% for private water vendors to conduct a survey using a structured questionnaire on the financial and institutional aspects of the private versus the public water market. In fact, all of the working ORET standpipes were included, which explains that the "treatment group" of ORET is smaller than the "control" group of private water vendors. In addition to the interviews, water quality was tested on pH, Colour, Turbidity, Conductivity, Temperature, Residual Chlorine and E. coli.

Annex A4 includes the questionnaire for the water vendors' survey in the Kwanyaku area and Annex, A5 for the households' questionnaire in Omdurman.

7. Results

7.1. Kwanyaku

Efficiency

According to the documents and the construction team, Kwanyaku I, II and III were completed and handed over to the GWCL as planned in 2008. Denys, the Belgian construction company, is currently still providing technical assistance/advice for the running of the plant, although Technical Maintenance Assistance (TMA) as part of the transactions was officially ended in 2010.

To ensure efficient and full-time operation, the Kwanyaku plant runs three shifts daily. The two plants are still in operation. Denys rehabilitated both the old plant (OWTP) with a 14,000 m^3 per day capacity and constructed the new plant (NWTP) with a 21,000 m^3 per day capacity. Together they are currently producing less than the designed capacity, i.e. in total between 20,000–22,000 m^3 daily. Reason being that the plant was designed with a time horizon of 25 to 30 years and a maximum production capacity higher than current needs, so that the new installations can contribute to increasing water demand in the future. However, even if demand would be as high as 35,000 m^3, it would not be possible to produce at full capacity primarily because of frequent power outages (see effectiveness). Nevertheless the plant's water production capacity is able to meet current water demand and has the potential to meet increasing water demand in the future. From a technical perspective, there are two separate distribution systems for the old and the new plant. In case of breakdowns, the new plant is able to pump water to the old plant for distribution in its network but not the other way round.

Maintenance at both plants seems to be a major problem because of delays in the delivery of spare parts. For instance, one raw water pump at the old plant broke down in 2008 and is yet to be replaced. The old plant is currently using the spare raw water pump of the new plant. According to the station manager, chemicals and other production inputs are sourced from the GWCL central depot in Tema but delays in procurement and delivery are a serious constraint to production at the plant.

In summary, the plant is producing at 63% of the designed capacity and provides water of good quality according to the regular testing results. In case of breakdowns local technicians improvise to the best of their ability to repair the machines so that the plant can keep running. They call on Denys which has a permanent office in Accra if they cannot solve the problem themselves. GWCL headquarters, which is responsible to respond to breakdowns and to ensure proper maintenance, reacts slowly (or not at all).

One of the major indicators for evaluating efficiency of GWCL are the figures for non-revenue water (NRW), i.e. water delivered without payments or lost due to water leakage. Since 2011, GWCL reports decreasing figures from 49% in 2008 to 46% in 2013. GWCL reports that 50% of NRW is due to physical losses (e.g. leakages in the pipes and network) and 50% is due to administrative losses (e.g. illegal connections or manipulated meters). However, these numbers are uncertain and have to be interpreted with caution. Calculating exact numbers is difficult because meters are lacking both at plant level and major transmission pipelines which make it difficult to estimate how much water is in fact produced and arriving at certain points in the system. Also on the user side, meters are often absent or not properly working and the number of illegal connections is unknown. The station manager of Kwanyaku and staff from GWCL noted that illegal water connections are a problem for GWCL which it is not able to handle. Box 1 reports the results of an in-depth interview with a water vendor on illegal connections.

Box 1: In-depth Interview with a Water Vendor on Illegal Connections

The vendor stated that it is common knowledge which households in the community have illegal water connections. Due to fear of backlash or reprisals, the other members of the community do not report these cases to the authorities. The water vendor was of the view that local workers of GWCL are also fully aware of the illegal connections. According to him, some individuals/households consider the water tariffs too high and thereby justify their illegal connection.

The head office of GWCL reports that water quality is monitored regularly. The standard Ghanaian quality indicators for *raw* water (intake water at plants) are pH, colour, turbidity, Alkalinity, Iron, Manganese, Pesticide (Nitrite), E. coli, Cadmium, Arsenic and Chromium. The treated water quality indicators are pH, colour, turbidity, hardness, residual chlorine, totally dissolved solids, Sulphate, Aluminium, Iron, Manganese, Fluoride, Nitrate, Arsenic, Nitrite and Ammonia.

The key indicators for GWCL to measure internal performance of production processes are a pH compliance index, colour compliance index, turbidity compliance index, residual chlorine and E. coli. According to the GWCL standards, water quality control should take place once an hour at different locations in the treatment plants. At the level of reservoirs and distribution points, water quality indicators are taken weekly. Interviews with staff of the regional offices and visiting laboratories of water treatment plants revealed that only the quality of the treated water is tested hourly as the procedures prescribe. Raw water tests are done less frequently, rather on a monthly or even a six months basis. Especially concerning heavy metals, e.g. Mercury, more frequent raw water tests should be done. Surface water from e.g. rivers in Ghana is often contaminated by the gold mining industry where Mercury is extensively used. As of now, there is no key performance indicator for Mercury contamination.

The station manager confirmed that there is a strict water quality regime in place. Seven water quality indicators (pH, colour, temperature, Residual Chlorine, Alkalinity, Hardness, and Turbidity) are tested ten times a day; records are documented and reported to GWCL. There is a water testing laboratory in operation with a laboratory technician and an assistant. Monthly water quality tests are carried out at the level of the reservoirs along the transmission pipes. The research team requested the water quality data of Kwanyaku at the district office of GWCL and at the water treatment plant which was promised but never received.

Box 2: In-depth Interviews with Water Vendors of the Water Committees

In one project village, one out of the five standpipes constructed by Denys was not in use because it has been shut down by GWCL for non-payment of the bills by the Water Committee. The other four previously public standpipes in operation are now all privately owned. According to the water vendors, these standpipes went into private hands because the agent appointed by the Water Committee did not pay the water bills (the agent is not the same person as the water vendor). The standpipes finally were closed down by GWCL 18 months after the start of operation. The shift into private hands took place after the vendors paid the accrued bills from their private resources. The fifth standpipe is currently not in use because the vendor has not yet been able to raise the required funds to pay the accrued bills. The interview with the vendor at the shutdown standpipe revealed that his commission was not paid by the Water Committee either, although he paid the all revenues to the assembly man. As bills were not paid, GWCL shut down this standpipe. The agent, who was supposed to pay the bill to GWCL, has not been held accountable because of his relationship with the village leaders.

The four standpipes which are now privately operated and owned are still running successfully. Comparing the first 18 months of operation (when the Water Committee was in charge of operations) to the last 18 months (in private hands), the water vendors interviewed believe that they are better off without the involvement of the Water Committee. The research team observed that the operations of the Water Committees do not seem to favour the water vendors. There is a general feeling that the revenues and profits made from the sales of water are not properly accounted for by the Water Committee.

Regarding the standpipe intervention, we were able to locate 118 out of the 122 constructed standpipes during the census of water sources. However, it turned out that 35% of the ORET standpipes are no longer in operation. It was reported that almost half of the non-operating standpipes have never been connected to the system. The other reasons why ORET standpipes are not working, were breakdowns and no repair (20%), bill not paid and therefore disconnected by GWCL (20%) and other problems with GWCL (10%) (see Box 2). Nevertheless, ORET added about 30% to the existing drinking water sources, i.e. increased water supply through public sources infrastructure by one third. For the survey we used all working ORET standpipes as the treatment group.

The operators of standpipes are very similar in their personal characteristics. Figure 11 below shows that the water vending business is primarily women's sector. The average age of the operator is 50.8 years and does not differ significantly between the treatment and control group. Most operators have basic education, that is they have completed primary school. Only few operators have a higher education level. Water vendors with no education represent about 20% of the sample.

Figure 11: Gender and Education Level of Operators

Effectiveness

Together the old and new water treatment plant in Kwanyaku produce between 20,000–22,000 m³ of water daily, which is less than the technically designed production capacity of 35,000 m³ per day due to production and distributional constraints. The new construction works and rehabilitation only increased water supply by one third instead of more than the planned doubling of production. The production constraints include power outages, low electricity voltage, weak high–lift pumps, and delays in procurement of inputs (chemicals). The largest challenge with the new system is the dependency of the new water infrastructure on the electricity grid, which has frequent problems of power outages.

There are also constraints on the distribution side. These include weak pipelines that often have breakdowns which require lower water pressure and limited supply in the current network. Although the designed capacity of the plant is much higher than current demand, it would at the moment not be possible to produce at the limit, mainly because of frequent power outages. Nevertheless the plant's water production is able to meet current water demand and has the potential to meet increasing water demand in the future. For end-users the availability of water certainly increased but the development of the number of household connections was not accessible for the research team. The number of public water points increased by one third resulting from the construction works of the project.

It is not possible to make a statement about water quality improvements because we did not get access to the historical water quality figures. Water from the standpipes is found to be of high quality concerning pH (average 6.88), residual chlorine (0.55 mg/L) and non-detectable faecal E. coli. The water is of rather soft quality, with calcium and magnesium levels far below the threshold of 100mg/L and 500 mg/L. Softer water is often preferred by customers because softer water requires less soap for foaming. Overall, the results of the 140 tested standpipes show that the water provided by the public and private water vending standpipes is generally of good quality, meets WHO standards (taken as national standards) and poses no health threat.

From in-depth interviews with end-users we learned that water is considered clean and safe for drinking and other household uses. However, one household head admitted that the household also uses alternative water sources because of the high price for drinking water at the standpipe. Sometimes the household fetches water from an open pond which is located at the town periphery town. The household head stated that this water is not used for drinking but only for bathing and washing purposes.

Sustainability

Institutional: Denys has still one third of the local staff (8 out of 25 employees) in Kwanyaku under contract for maintaining the plant and supporting GWCL staff. These costs are born by Denys and not by the ORET project budget. According to the local managers of Denys the TMA period of two years as part of the project is not sufficient to develop a *'culture of maintenance'* under the local employees. An additional problem is that staff of GWCL often changes and knowledge is not transferred from one generation to the next.

On the user side, at standpipe level, management is organized differently between the treatment and control group. While 98% of the ORET standpipes are publicly owned, i.e. by the village population represented through the Water Committee, only about 10% of the standpipes in the control group are publicly owned. Only 2% of the ORET standpipes are privately owned and operated (see Box 3). The publicly owned system requires rules on sales and revenue collection but also on the organization and responsibilities of the Water Committee and the water vendor. Operators of the ORET standpipes were usually selected by Denys, upon recommendation of the Water Committee. To become a responsible operator on behalf of a Water Committee, the vendor had to register with GWCL as the addressee of the water bill. The private water vendors paid GHS 900 for getting the household connection, of which about GHS 400 are paid to GWCL for the connection to the main distribution pipes and GHS 500 are spent for the construction of the tap and a concrete basin. For the ORET standpipes, all these cost were covered through the project.

Table 7: Contacts with GWCL and Local Technicians

	How responsive is the technician to your request for technical assistance after a breakdown?			How responsive is GWCL to your request for technical assistance after a breakdown?		
	Control	Treatment	Total	Control	Treatment	Total
Very prompt	57.1%	57.8%	57.4%	9.1%	12.5%	10.6%
Slow	31.2%	26.6%	29.1%	15.6%	9.4%	12.8%
Very slow	11.7%	15.6%	13.5%	29.9%	35.9%	32.6%
Never	0	0	0	45.5%	42.2%	44.0%
Total	100	100	100	100	100	100

Source: Water vendor surveys 2014

Another institutional challenge for the water vending process is who water vendors can contact in times of breakdowns of the standpipe. In case of a breakdown, about 75% of water vendors call a local technician to do the repairs; there is no difference between the two groups. Only 20% of standpipe owners call GWCL for assistance and the remaining 5% call a technician from a nearby town or do the repairs themselves. Private technicians tend to act much faster in providing repair services than GWCL (see Table 7). While more than 50% of respondents in both the treatment and the control group receive prompt attention from a local technician upon request, the response of the GWCL to such calls is either very slow or never happens, according to more than 70% of respondents from both samples. Thus statistically, there is no significant difference between the treatment and control group when it comes to the responsiveness of both the local technician and GWCL to calls for repairs, but clearly GWCL is very slow in serving their clients or does not support them at all.

Box 3: In-depth Interviews with Water Vendors on Repairs

The vendors revealed that there are considerable delays in GWCL's response to reported breakdowns at the standpipes. Concerning maintenance, the water vendors mentioned that the responsibility for operation and maintenance is not clearly defined between the vendor and the Water Committee. One water vendor claimed that when the standpipe developed a fault six months ago, it had to be closed down and wait for repairs until the next meter reading day, losing sales. The vendor then had to pay the repair costs of GHC 50 from his own pocket. Private water vendors do not make use of GWCL services and organize needed repairs with private technicians directly. A possible concern here is that local technicians may have insufficient knowledge of water technologies. In another village, the water vendor of an ORET standpipe stated that she pays repairs out of her own pocket. In the case of a privately owned and operated standpipe, the operator is responsible for repairs. In the case of publicly owned standpipes, the water vendor is still responsible for operation and maintenance and often has to pay the repairs from his own pocket, although this should be paid from the revenues collected by the Water Committee.

Technical: There are constraints for the technical continuity of the water treatment plant at two levels: the first is the lack of maintenance culture at the level of the drinking water plant, the second is the lack of proper spare part management at the level of GWCL. The *'culture of maintenance'* is important to guarantee water production in the future according to international standards. Proper maintenance and timely repairs of the equipment are therefore of utmost importance to the technical sustainability of the plant. For instance, a first comprehensive inspection of the water treatment plant should have been done in 2013, five years after the start of operations, in addition to regular maintenance. However, there was no inspection of the plant since the installation has been handed over in 2008. As Denys is still paying for staff support and repairs, it is uncertain what would happen in case Denys decided to stop this practice. If Denys would no longer provide supervision of the plant, it might result in less attention to maintenance and fewer financial means for repairs. On the other hand the ongoing presence of Denys may also absolve GWCL from taking full responsibility for the plant.

In addition to the absence of maintenance, the lack of spare part management is threatening technical sustainability. Bureaucratic procedures within GWCL hinder the release of funds for the procurement of spare parts. GWCL has only one central depot for spare parts in Tema (east of Accra) where regional water production managers have to order their technical replacements. However, spare parts have to be ordered via the local GWCL offices and not directly in Tema. This bureaucratic hurdle increases the processing time for getting replacements installed.

A further risk for the sustainability of the new water infrastructure of the water treatment plant is its dependency on the electricity grid that has recurrent power outages. Leakages in the distribution system were identified as another major concern. This problem has worsened because GWCL has no system to identify and manage breakdowns rapidly and pipe materials and spare parts are not standardized for the distribution network. This poses serious problems in times of repairs because old and new pipes can only be connected with difficulty and extra cost.

Table 8: Breakdowns and Costs of Repairs

	Days out of order last breakdown	Cost of repairs in last 6 months	Sufficient funds for paying repairs
Control	21.43	60.81	0.94
(se)	(4.587)	(10.377)	(0.028)
Treatment	45.72	63.00	0.84
(se)	(10.941)	(26.459)	(0.046)
p-value	0.0425	0.939	0.0917

Source: Water vendor surveys 2014, *** p<0.01, ** p<0.05, * p<0.1, se is standard errors

At standpipe level, there is a statistically significant difference between ORET standpipes and private water sources in terms of the number of days a standpipe was out of order during the last breakdown (see Table 8). Although the technician might react promptly, delivery of spare parts for the standpipes needs time since they have to be ordered from Kasoa or Accra. The number of days the standpipe was not in operation is only 21 for private water vendors compared to 45 for ORET standpipes. This may be due to the fact, that ORET standpipes operators are less likely to have sufficient funds for repairs. Only 84% of ORET standpipe operators report to have sufficient funds while 94% of private operators have the financial means to pay for repairs. This difference is statistically significant on a 10% level. The cost of repairs paid during the last 6 months does not differ significantly between the two groups.

Financial: An additional threat to financial sustainability is the current water tariff system. Tariffs charged by GWCL are already too low to cover operational costs and salaries, disregarding any costs for maintenance let alone debt servicing of the loans or replacement in the future. The official tariffs set by GWCL are also often not paid in full by end-users. This seems to happen especially in areas with private household connections where richer people live, because flat rate tariffs from the past have not been adapted. The public standpipes we observed during the survey all except two do have a working meter. On average, about 80% of the water vendors in both the treatment and control group indicated that they regularly receive water bills from the GWCL, while another 15% indicate that they receive these bills less regularly. About 5% in the control group indicated that they never receive a water bill. There is no significant difference between the treatment and control group regarding the regularity of receiving bills. Usually both the private water source owners and responsible operators of ORET standpipes pay the water bills to GWCL.

There is a difference in the prices charged to end-users between ORET standpipes and private water vendors. This difference is statistically significant at 5% level, as shown in Table 9. The mean price for a 34 litre container of water for the control and treatment samples is GHS 0.14 and GHS 0.12 respectively. The treatment and control group are not statistically different in terms of the mean quantity of water sold. The monthly revenues (both the calculated and the self-reported mean) from water sales for the treatment group are higher compared to the control group because they sell more water. This difference, however, is not statistically different in either case, implying that both groups earn comparable revenues. It is worth noting that the calculated mean revenues for both the treatment and control groups are higher than the self-reported mean revenues, which can be an indication of under-reporting of revenues. Only 5% of ORET standpipe operators share their profit with the Water Committee while all other operators (treatment and control) keep all revenues for themselves. This also justifies the responsibility of ORET operators to pay for repairs but still the division of responsibilities between operator and water committee is not clearly defined.

In summary, ORET standpipes are cheaper and sell more water but this difference is not statistically significant. Regarding the poverty aspect of the programme, the ORET standpipes give poor people cheaper access to water.

Table 9: Price, Quantity Sold and Revenues of Standpipes

	Price 34 litre bucket(in GHC)	Quantity sold in m³	Monthly revenue calculated	Monthly revenue self-reported
Private standpipes	0.14	35.94	132.79	119.41
(se)	(0.005)	(5.475)	(19.634)	(9.213)
ORET standpipes	0.12	56.02	193.24	142.71
(se)	(0.005)	(11.341)	(41.614)	(11.626)
p-value	0.0140	0.114	0.192	0.118

Source: Water vendor surveys 2014, *** p<0.01, ** p<0.05, * p<0.1, se stands for the standard error.

There is a difference, however, between the two groups regarding who determines the price of water from the water source. The price for selling water is largely set by GWCL for ORET standpipes in the treatment group whereas private standpipe owners in the control group can define their own price. For instance, 72% of respondents in the control group set their own price while only 28% rely on the price set by GWCL or the Water Committee. In contrast, 57% of respondents in the treatment group rely on the price recommendation of GWCL or the Water Committee whereas 43% set prices on their own. This difference is statistically significant between the two groups at a 5% level.

There is a pro-poor element to the standpipes constructed under ORET as these water points offer water for a lower price (GHS 0.12 per container of 34 litres) than the private operators (GHS 0.14).

One interviewed household head revealed that he would be willing to pay GHC 100 for constructing a household piped water connection and a monthly flat rate of GHC 20 for water usage. At the current price level at the standpipe of GHS 0.14 for a container of 34 litres, a flat rate of GHS 20 would be advantageous if the monthly consumption would be above 4.8 m^3 (in addition to the time savings and the ease of not having to carry the heavy containers). A flat rate would probably encourage more use of water. However, at a price of GHC 100 it is not possible to construct a household connection. The private standpipe owners in the control group of our sample who paid personally for the water source, spent on average GHS 409 to GWCL for the connection to the network and GHS 528 for the construction of the pipes and tap.

Ecological: As Denys is still active in managing the plant, although not officially, the hygienic standards are well maintained. For example the sludge from the water treatment plant is disposed and even used as fertilizer for mango trees, leading to extra income of the population living around the Kwanyaku plant. When Denys would leave the plant, it is not guaranteed that these standards will be maintained since the Denys manager reports that they still have to regularly instruct staff on sludge disposal and other environmental issues.

Box 4: In-depth Interview at a Public Sanitation Facility

The research team visited a public sanitation facility constructed by Denys for a community near Kasoa which was part of the ORET transaction. The public toilet facility is situated on the main road between Accra and Cape Coast and is frequented by surrounding neighbours and travellers. Latrines are separated with four latrines for each sex. Latrines were in general clean and walls were painted with pictures explaining the hygienic steps for defecation and hand washing. The toilet facility is managed by the local 'Water Committee' with an old lady in charge as caretaker. The rate for usage of the toilet is GHS 0.20 (approx. 5 cent EURO). The onsite public standpipe serves the surrounding households. The charge for a 34 litre container is GHS 0.15.

The revenue of the toilet facility is approximately GHS 700 per month, implying 3,500 users on a monthly basis (116 users per day), while the average monthly water sales are about GHS 900, or approximately 200 m^3. While the water revenue seems reasonable, the number of reported users of the toilet facility seems quite high, given that during the field visit very few customers were using the toilet facility. The total revenue of the publicly run facility sums up to GHS 1,600 per month. The monthly water bill of the GWCL amounts usually to GHS 500; the earnings of the caretaker amount to only GHS 80 per month, which is far below the minimum wage of GHS 6/day, but the payment is topped up by an additional daily allowance of GHS 2 per day (approximately GHS 60 per month). Costs incurred for inputs, including toilet paper and detergents are paid by the caretaker using the revenues. The profits of the toilet facility of GHS 960 go to the local Water Committee.

This small example shows that a public toilet facility that also offers drinking water to the local and travelling population can make a considerable profit. There is some reason for hygienic concern at the premises of the facility. The faeces and water flushed from the toilets is first collected in a closed sewage tank after which the water is separated. The dirty water then runs off in an open pond. The open stagnant water in the pond may pose a health hazard to people living in the area although we did not smell any unpleasant odours on-site. The sewage tank is emptied by a tanker truck when it is full.

Social: Access to clean and affordable drinking water is of high importance to the population of the Central Region in Ghana and therefore a priority for policy makers. Increasing population growth and concomitant rising water demand will require constant improvement of the water system. For this to materialize, it is necessary that all people benefitting from the water treatment plant also pay for the water they consume, the rich, the poor, companies and governmental institutions. Illegal connections, manipulated meters and a culture of non-payment for water pose clear threats to the sustainability of such a water system.

7.2. Tamale

Efficiency

The water situation in the region around Tamale is alarming. Tamale is one of the fastest growing cities in West Africa with an approximate population of 400,000 inhabitants. The permanent migration to the city is visible in the construction works of houses and the constantly expanding periphery of the city. The Tamale water treatment plant is the only water production site in the region. According to the regional GWCL manager, Tamale needs an additional water treatment plant rather sooner than later as the current water treatment plant is already producing at the limit.

The Tamale water treatment plant was not supervised by Biwater after the plant was handed over in 2008, as it was a turnkey contract. When the plant was still in the planning phase, it already became clear that the capacity of the plant would probably be too low to meet water demand of the Tamale population in the longer run. The plant was designed with the ORET transaction ceiling of € 45 million in mind but with the clear knowledge that its production will not be enough to meet demand already in the near future. Nevertheless the project increased water availability in Tamale by 25,000 m^3 per day, more than doubling the amount available before the new plant was installed.

Under the TMA-part of the project, Biwater installed a Geographic Information System (GIS) based supervision system and computers for controlling the water distribution network in the districts of Tamale. As the project manager reported, this computerized supervision system is not functioning anymore because current employees lack the skills to handle the system properly. Also during the field visit it became clear that advanced techniques seem to break down rapidly because of improper handling. The staff of the water treatment plant is dedicated to keep the water running because they know how important this is for the people but the management and the institutions of the water system are weak.

Regarding the production process, the plant managers' words *"we are managing"* become meaningful in the context of the plant. The staff seems really dedicated to have the water run constantly, in large amounts and of good quality. Hourly tests of water are done in the on-site laboratory from morning till evening. In case of deviations from the drinking water standards, the production process is adjusted accordingly by adding Alum, Lime or Chlorine. However, some of the equipment constructed and installed under the ORET project is not working anymore or not properly.

Starting with the intake pumps, there are two old and two new pumps currently in use. The two new pumps were already refurbished once by GWCL Kumasi. The station manager requested a new pump a long time ago, but nothing happened until now. The transmission pipelines for the raw water intake from the river to the plant are in use but the old pipe is leaking causing a clearly visible pond in a field close to the plant. An obstacle to have it repaired is that the pipe is underground and there are no adequate tools and machines available for digging it up.

The distribution chambers for mixing the raw water with Alum before filtration of both plants are not working properly in technical terms. Water is mixed with Alum but not as efficient as possible. At the old and new plant, the main problems are the scraper bridges that are not rotating anymore. This is because the sludge is not regularly disposed of and therefore the rotating bridges get stuck. At the new plant an additional problem is that one of the chambers is leaking.

Especially the Lime and Chlorine disinfection units at the new plant pose a problem. Both installations are not functioning anymore because the pipe systems for adding Chlorine/Lime broke down. The station manager pointed out that from the beginning these systems were not working properly because the distribution pipes were made of a weak material, although it rather seems to be a problem of improper handling to us. The main problem seems to be that due to regular power cuts, the pipes for Chlorine and Lime have to be flushed causing the loss of production time and potential output. If the system is not flushed, the mixture of chemicals and water dries up, fills the pipes and blocks the system in the end. The staff at the plant installed an improvised Chlorine and Lime system, but the dosing of chemicals might be incorrect. If the installed system would have been maintained properly, especially because of the frequent power cuts, it is very likely that it would still be working.

The biggest concern for the plant which is also causing a financial problem, is the inadequate power factor equipment at the plant. The power factor is a measure of the efficiency of power transmission. The power factor is defined as active power (P)/ apparent power (S); usually it should be close to one (0.90 to 0.95) but currently it is below 0.90. The installed equipment should correct the apparent power (S) to equal active power (P) drawn from the system. If the power factor is low because P is low and S is larger, than the plant draws more electricity from the grid than it actually requires. The lack of regulation of power at the plant costs approximately GHS 30,000 a month. This can be seen as a sanction from the electricity provider to GWCL because of the overuse of the grid.

The Tamale water treatment plant has a strict water quality regime in place as well. Eight water quality indicators (pH, colour, temperature, Residual Chlorine, Alkalinity, Hardness, and Turbidity) are tested daily. During the day, water quality tests are done on an hourly base, records are documented and reported to GWCL. There is a water testing laboratory in operation with a laboratory technician.

The water demand of Tamale is growing rapidly because of the new population that has to be served. New industries need clean water and new houses are equipped with more water facilities for washing, sanitation and bathing which increase demand even more. In the area around Tamale a new industry of sachet water producers has developed who use the drinking water from the water treatment plant as input. The sachet water producers not only sell the drinking water in Tamale but also in other areas of the Northern region.

According to the regional manager almost all areas have water access 24 hours a day. An important challenge is the low water pressure in the pipes which causes less provision for the uphill areas of Tamale. Here, water often does not run 24 hours a day, especially not in the morning and early evening when demand is higher and the pressure in the pipes is lower. The area which suffers most from low water pressure is Changle where mostly middle class families happen to live. The poorest areas, Tolong and Kumbungu, are not affected by low water pressure because they are situated in areas along the major transmission pipes coming from the treatment plant.

Also in Tamale illegal connections and leakages from the pipes are a permanent problem. GWCL does not have a system in place to detect leakages nor do they have the human and physical capacity to control all pipes regularly. Pipes usually lie on the surface and are not below ground. This makes illegal tapping of the pipes easy.

In technical terms, the water treatment plant provides clean water at almost maximum designed capacity for the population of Tamale. However, the whole production process is a rather improvised system that is vulnerable and not efficient and production reaches its limits.

Effectiveness

The production capacity of the plant is 45,000 m³ per day. The new installations under ORET contributed an additional 25,000m³ per day. The current production plan shows that the plant usually produces between 41,000 and 44,000 m³ a day. Production at maximum capacity is not possible because of frequent electricity outages. So while the plant is not reaching its production potential, it has more than doubled the water supply in the Tamale region. Noticeably, the population of Tamale named a new district “Biwater junction” according to the company that extended the treatment plant. Most of the households in the newly constructed areas do not have household connections but take their water from privately or publicly operated standpipes.

Public standpipes are more often privately managed though they were originally installed by GWCL. The water vendor responsible for operation also pays the bill to GWCL without any role for a water committee. The water vendor and the women frequenting the public standpipes explained that in general there are no problems with water availability but that sometimes the water is not running for hours or days. According to them there was no water at Biwater junction for 2 weeks in March 2014. The regional manager denied that this was the case.

There are also several privately owned and operated standpipes and households with household connections where no meter has been installed. These operators pay a flat rate price of GHS 60 per month to GWCL and then resell water to the public at a higher price than the public standpipes probably generating a considerable profit. GWCL is apparently unable or unwilling to deal with these operators.

Sustainability

Institutional: Biwater handed over the treatment plant in 2008. There was a six month period of TMA, which was not sufficient to develop a *'culture of maintenance'* among the local employees. An additional problem is that the local management of the water treatment plant did not want to attend the courses given by the staff of Biwater and that they are reluctant to handle the new technologies in an appropriate manner. This mainly concerns the new Chlorine and Lime installations that need special attention in maintenance, especially because of frequent power outages as it is the case in Kwanyaku.

Technical: The *'culture of maintenance'* is important to guarantee water production in the future according to international standards. Proper maintenance and repairs of the equipment are therefore of utmost importance for the technical sustainability of the plant. Since longer supervision by Biwater was not included in the contract, this culture did not really develop and even now there is not sufficient maintenance. In addition the spare part management is not properly functioning which threatens the technical sustainability of the plant.

Financial: An additional nationwide threat to financial sustainability is the current water tariff system. Tariffs charged by GWCL are in fact too low to cover operational costs and salaries, disregarding any costs for maintenance. The official tariffs set by GWCL are also often not paid by end-users in Tamale, as there are a lot of illegal connections along the 30km distribution mains that was constructed in the 1960s from the plant to town.

Ecological: Hygienic standards are not well maintained as the sludge is not removed properly but just dumped somewhere close to the plant. This does not cause an environmental concern but money is being wasted. It could be used as fertilizer for leading to extra income of the population living around the plant but the staff of the plant regards the sludge as simply waste.

Social: Access to clean drinking water is of high importance for policy makers and the population of the Northern Region in Ghana. Increasing population growth and water demand postulate constant improvement of the water system. It is necessary, that all people benefitting from the water treatment plant also pay for water, the rich, the poor and the governmental institutions. Illegal connections, manipulated meters and a non-existing payment culture for water pose clear threats to the sustainability of such a drinking water system.

7.3. Barakese

Efficiency

The goal of the project was to reduce the water shortage in the city of Kumasi by expanding the production at the Barakese purification plant by 54,600 m^3 per day and by renovating the existing purification plants in Barakese and Owabi, as described in the input section. These targets have been reached, though there is still a water shortage in Kumasi, but this was already known during the ORET application procedure. The underlying problem is the increasing population growth in the area around Kumasi, and the stagnating or even decreasing capacity of other available and reliable drinking water sources.

The Barakese plant project was originally assigned to Taylor Woodrow Construction BV, who involved a local company in Ghana -Taysec - as a subcontractor. Taylor Woodrow started the construction together with the engineering consultancy firm Royal Haskoning who was responsible for the design, supervision and training. These elements were all part of the same ORET-transaction. During the first year of construction, however, Taylor Woodrow went bankrupt and the project was handed over to Ballast Nedam. The Grant Appraisal document did mention that the partner Taylor Woodrow was regarded as "not very strong" and that a "performance guarantee" by the mother company was needed. Nevertheless the company was seen as very experienced although its experience was gained in developed countries, not in developing countries. Clearly there were warning signals from the beginning that Taylor Woodrow might not be up to the task. Taylor Woodrow had no experience in these kinds of projects in developing countries and was not able to do a convincing job. Civil engineering works had already started when Ballast Nedam had to step in.

Ballast Nedam bought the project completely from Taylor Woodrow early 2009, by pricing all goods and works done to date at market rates. Ballast Nedam did not agree with the work done thus far by Taylor Woodrow because related mechanical and electric parts of the plant were not constructed in parallel. In 2010, an additional commercial loan of € 12.5 million, provided by the ING Bank and carrying Dutch export credit insurance, was arranged to be able to finance the further extension of the Barakese water treatment plant. This loan was not part of the ORET transaction.

Because the project was taken over about halfway from Taylor Woodrow, and was not developed on the basis of methods preferred by Ballast Nedam (solid preliminary research, clear contract, etc.), some adaptations were necessary in the design and during implementation. Since this had to be done in a relatively late stage, this caused many (unnecessary) last minute changes and late orders, and higher cost. Despite the mid-term take-over of the project from Taylor Woodrow, the project did not encounter significant problems during implementation and was still completed on time.

Like the other water treatment plants the Barakese water treatment plant also has a strict water quality regime in place. In total, seven water quality indicators (pH, colour, temperature, Residual Chlorine, Alkalinity, Hardness, and Turbidity) are tested daily. During the day, hourly water quality tests are being done, records are documented and reported to GWCL. There is a water testing laboratory in operation with a laboratory technician who has several assistants and trainees. Overall, the laboratory of Barakese seems overstaffed: about 6 people were present when visiting the facility.

Effectiveness

The project increased the water supply capacity by about 54,600 m^3. Prior to the project, the plant had three production modules producing each 27,000 m^3 of water a day. The existing three modules were rehabilitated under the project while two new ones were added. The maximum production capacity is now 135,000 m^3 a day but usually the plant produces around 100,000 m^3 a day. The plant is not producing at maximum capacity yet, mainly because there are distribution and electricity problems. The current distribution system of Kumasi is not able to handle larger water quantities. Pumping higher volumes would require raising the pressure in the current pipes so much that it could cause bursting of the pipes. What is currently needed and already planned is an extension of the distribution mains from the plant to town, which covers a distance of 20km. Another serious problem reported by the water treatment plant management is the regular power cuts which may cause a loss of six production hours per day.

Sustainability

Institutional: Since the project was designed as a turnkey contract, Ballast Nedam handed over the treatment plant in 2010 to GWCL. There was one extra year of TMA included in the project. The Barakese plant seems to be well organized in administrative terms with a team that is highly committed to produce water at high quality standards. The station manager is aware of the huge power problems in the region and tries to save electricity where possible. Maintenance such as cleaning the clarifiers and other installations takes place regularly while the plant appears clean and well kept.

Technical: The current production does not reach its maximum but this is mainly due to power cuts and the inadequate distribution mains which cannot handle larger quantities of water. All technical systems are working as planned. The planning for an extension of the distribution network is ongoing but there are financial constraints which hinder the extension of the system.

Financial: A threat to financial sustainability is the current tariff system. Tariffs charged by GWCL are too low to cover operational costs and salaries, disregarding any costs for maintenance.

Ecological: The hygienic standards are well maintained as e.g. the sludge is disposed of properly and the plant is maintained well and kept clean. The lake reservoir faces more run-offs due to illegal logging of the surrounding forest reserves in the catchment area.

Social: Access to clean drinking water is of high importance for policy makers and the population of the Ashanti Region in Ghana. Increasing population growth and water demand require constant improvement of the water system. It is necessary, that all people benefitting from the water treatment plant also pay for water, the rich, the poor and the governmental institutions. Illegal connections, manipulated meters and a non-existing payment culture for water pose clear threats to the sustainability of such a water installation. Box 5 gives insight into the situation of end-users in Kumasi.

Box 5: In-depth Interviews with End-Users in Kumasi

The lack of any sewage system is visible right after one enters the residential areas along the main roads of Kumasi where a lot of people still fetch water from standpipes. Boreholes around the city still exist and some areas make intensive use of groundwater as their main water source. There are many urban areas where no piped connections in the houses exist and people rely on standpipes of private vendors, public water vendors or traditional sources. Only 69,000 households are connected to the piped system in Kumasi. Newly build areas and poorer neighbourhoods are served by 1000 standpipes in the metropolitan area. Some areas in Kumasi are already covered by household connections but the city is constantly growing and water consumption is continuously increasing. A rapid increase in private connections is necessary to use the larger amounts the Barakese plant could produce.

In a poorer neighbourhood, we found people who still fetch ground water from a traditional well for cooking and cleaning. Some poor families also use this water for drinking as the water from the standpipe is too expensive for them although they are well aware that the water of the well could be contaminated. A group of residents from the settlement had pooled resources to buy two concrete sanitation pipe rings to construct the traditional well themselves. The rings served to protect the walls of the well but the top ring was only 25 cm above the ground and was not covered on top. Especially in the rainy season the traditional well fills up with rain water flowing downhill from the settlement area. This rain water is mingled with the sewage water and can be considered highly contaminated with faeces and household trash. The sewage water may also seep into the well via the ground water table because the well is only a few meters deep.

In another, more residential neighbourhood with better concrete houses, the main public water sources are several deep boreholes. The water is pumped from a considerable depth by an electrical pump. The cost of the pump and the electricity is funded by the local municipality and the households in the area get the water free of charge. There were also some private households who sell water from a standpipe outside their house. We even found an exceptional case where one single household was responsible for managing a traditional well, a hand-pump on a borehole with the construction funded by an Islamic charity group, and a public standpipe in their yard. All water sources were used in parallel with the advantage that the water from the traditional well and the borehole came for free. People preferred the taste of the water from the deep borehole which was perceived to have a sweeter and more natural taste than the treated (chlorinated) water from the standpipe.

7.4. Al Manara

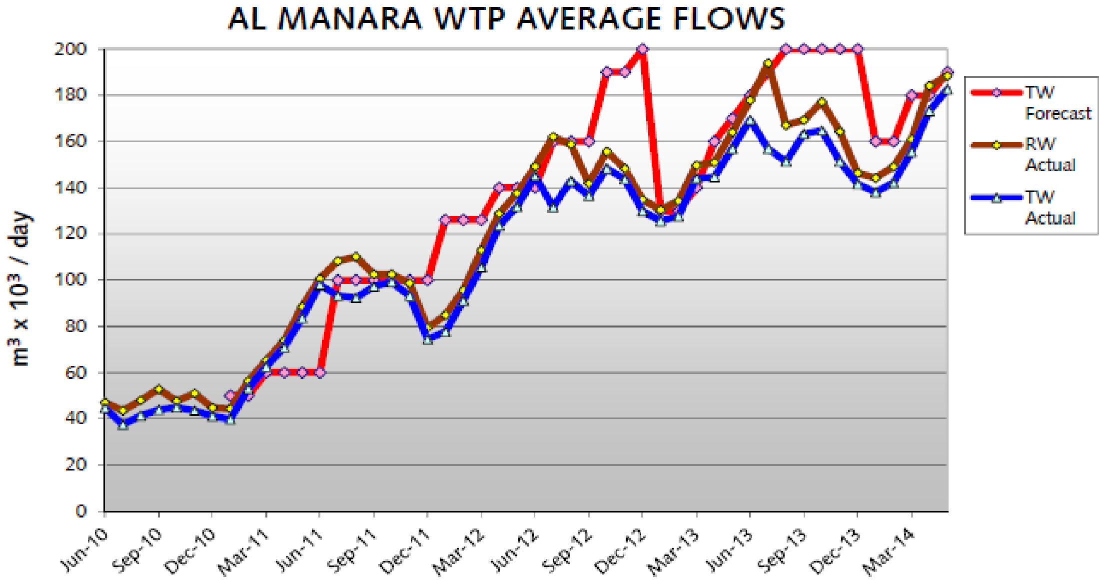
Efficiency

Al Manara currently produces 80–90 % of the potential production capacity and almost reaches its limits, i.e. producing around 180,000 m^3 per day. Figure 12 shows how production has steadily increased since 2010 with a temporary decline in the second half of 2013. Problems for water production are mainly the slow increase of household connections and improvements of transmission pipelines by KWSC.

The ORET grant and loan payments have been disbursed on time. The implementation of the construction was successful in technical terms, despite some delays in the work. These delays occurred mainly because some imported construction materials were stuck in customs.

The supply area is divided into five water supply zones, namely Al Manara, the Al Gamayir Tank, Al Thoura Tank North, Al Thoura Tank East and Al Thoura Tank South. Each of the water supply zones comprises of a number of District Metering Areas (DMAs) which comprise at least one but usually four residential areas (Haras) and have approximately 2000 connections per DMA. Each DMA requires an own distribution network from the main pipe to each road and then to each house.

Figure 12: Al Manara Water Production



Source: Al Manara Report May 2014; TW=Treated Water, RW=Raw Water

The main water pipelines running from the Al Manara water treatment plant to the Al Gamayir and Al Thoura reservoirs and the primary main from the plant to Al Manara North were constructed under the project. The system is designed to distribute the 200,000 m³ of water produced by Al Manara water treatment plant, divided over the supply zones as follows:

- 130,000m³ to Al Thoura
- 60,000m³ to Al Gamayir
- 10,000m³ to Al Manara North

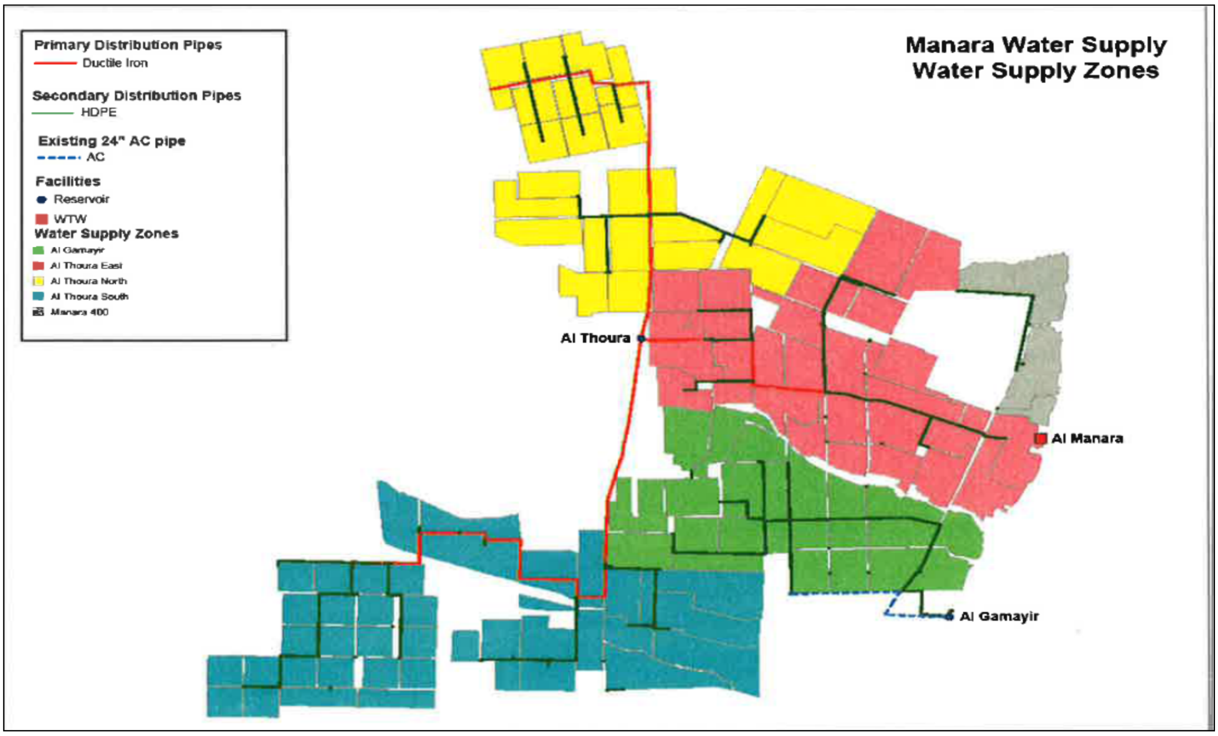
KSWC is responsible for managing the construction of the primary and secondary distribution mains from Al Thoura Reservoir and Al Gamayir reservoir. These mains deliver water to the Haras in the water supply zones described above. The routes of the primary and secondary distribution mains are shown on the map below in Figure 13. The primary mains (shown in red) are being constructed in ductile iron cement lined pipe and the secondary mains (shown in green) are being constructed in locally produced HDPE pipe. In total the Al Manara plant serves 113 DMAs in the supply area comprising 249 Haras. During the construction of Al Manara between 2007 and 2010, Biwater also installed a Water Asset Management (WAM) system together with KSWC. The household properties were listed and the billing system was revised. In the beginning, there were only 96.000 customers billed out of a total of 254.000 houses. This number increased to 145,000 until 2011 and currently there are 154,337customers connected to Al Manara.

Assuming an average household size of seven to nine persons (i.e. number of users) the number of beneficiaries is estimated between 1.2 to 1.4 million people. Usually, Al Manara provides water 24 hours a day; however during times of power cuts no water can leave the plant or reservoirs but electricity is no major problem here. The population frequently complains about water cuts which can either stem from the production side or problems in the distribution network.

Since water is also distributed to Al Gamayir (Figure 13 green area) and the Al Thoura Reservoir, which supplies Ombadda (Figure 13 blue area) Al Manara produces near its maximum capacity of

180,000m³ per day. Before, water production was constrained because KSWC failed to construct and connect the required networks as foreseen and was therefore not able to distribute the water to the population.

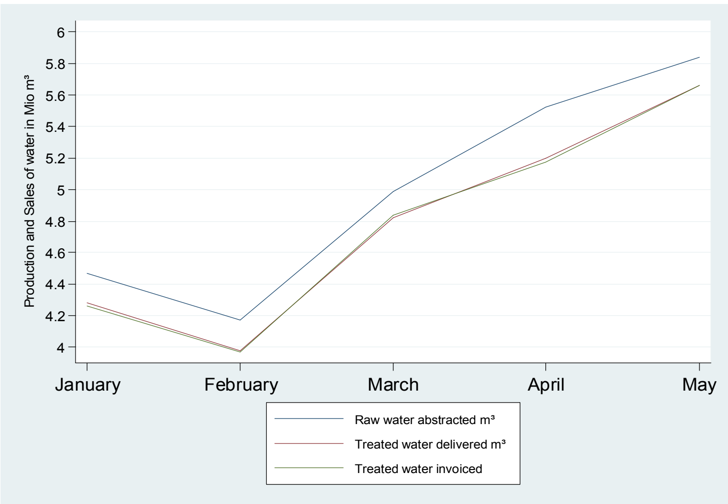
Figure 13: Al Manara Catchment Area



Source: KSWC Distribution Network Progress Report, 2011

Figure 14 shows Al Manara's total monthly water production and sales in 2014. As the treated water delivered and invoiced to KWSC is almost equal, the amount of unbilled water is close to zero. 'Water delivered' is the internal figure of Al Manara and is based upon reading of the flow meters at 23.00 hours each day. KSWC staff visit on the last day of each month, and reads the same set of flow meters to determine the volume of 'Water Invoiced'. However, because the time of the visit of KSWC is generally early afternoon, and may vary by a few hours every month, there is always a slight plus or minus discrepancy between the 'Water delivered' and 'Water Invoiced' values. Over the course of a year, they are generally very close to each other.

Figure 14: Al Manara's Water Production



Source: Monthly Statistics, Al Manara 2014.

At the household level the amount unaccounted for water estimated by KSWC for Greater Khartoum is around 30% to 35%. This number is the difference between the revenue from water sales to end users and the amount paid for total production of water in Sudan's capital. KSWC, however, did not make the financial statements and figures about NRW available to the research team.

The household survey conducted in 2014 shows that households have on average 6.7 members with 1.3 children below the age of five. Demographic information from 2008 is not available. Table 10 shows that in 2007, 86% of households had a piped connection while in 2014 on average 98% have a household connection in the Kararie locality (catchment area of Al Manara). Unfortunately the survey in 2007 was not representative for the whole area covered by Al Manara. Therefore we sampled an additional 100 households in Al Fateh, an area where KSWC planned to build piped connections during the last years. Here the numbers of household connections are very different. Only 36% of the sampled households have a piped connection while the majority buys water from water vendors. Most piped connections were only constructed in 2013.

Table 10: Piped Connection Al Manara Catchment Area

	Piped Connection	Al Fateh Piped Connection
2007	0.86	
	(0.011)	
2014	0.98	0.36
	(0.005)	(0.052)
p-value	0.000	0.000

Source: Household Surveys 2008 and 2014.
Colum 1 shows the p-value 2008 to 2014; Column 2 shows the p-value for Al Fateh and other survey regions, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

The majority of households not connected to the piped system (88%) buy water from donkey card water vendors. Only 50% of the households know where the vendor purchases the water. In case households do know the source, it is a water kiosk, a public standpipe, a protected well or another household with a piped connection.

Households usually buy water in jerry cans (25 litres) or barrels (200 litres). The price per jerry can varies between SDG 1 (€ 0.14) and SDG 5 (€ 0.75), the cost per barrel varies substantially between SDG 15 (€ 2.1) and SDG 70 (€ 10). About 70% of households buying water from vendors received all the water they demanded during the week before the interview. About 30% of households indicated that due to insufficient water availability or lack of financial means they could not buy all the water they needed for daily purposes.

Water quality samples are collected at designed sampling points at the Al Manara water treatment plant in accordance with the frequency required by the BOOT Agreement. They are analysed in the site laboratory to determine compliance of the primary parameters to the limits defined in the BOOT Agreement. The treated water is tested at the delivery point of the water treatment plant and has to comply with the Water Supply (Water Quality) Sudanese Regulations and the WHO Guidelines for Drinking Water Quality. Independent monitoring of water quality from Al Manara Water Treatment Plant is also carried out by the Khartoum State Ministry of Health and the KSWC.

The indicators are analysed once a day for raw and treated water are: Turbidity, pH, colour, Alkalinity and temperature. The water quality indicators are under strict control of the management and deviation from standards for drinking water leads to adjustments of the disinfection process. The population of Khartoum is of the opinion that Al Manara produces the best water quality in Khartoum. This production of high quality water gives rise to debates between the production and political/administrative stakeholders. Politically, the priority is to produce as much water as possible to serve more people while the production managers give priority to produce water of a high quality as it was agreed set in the contract between Al Manara and KSWC.

Effectiveness

From a technical point of view, the project is successful in providing drinking water of high quality at the water plant level. In addition to the water treatment plant, transmission pipes to reservoirs were installed while in Thoura a new reservoir was built. At an average production of 180,000m³ per day AMWC estimates that it serves around 1.2 to 1.4 million persons. Assuming 1.4 million beneficiaries, one connection would serve 9 users with 128 litres per capita per day as officially 154,337 connections are registered with KSWC for Al Manara.

If the average daily consumption is assumed to be 150 litres per capita per day as estimated by KSWC, there would be only 1.2 million beneficiaries given the current daily water production. However, since meters are lacking, it is not possible to give exact numbers of beneficiaries and daily consumption. As figures on the development of household connections were not available from KSWC it is impossible to report on the change in coverage rates of household connections.

At the level of beneficiaries, the most often stated problems concerning water supply in 2014 are frequent water cuts (38%) especially in the summer (15%) and the low water pressure (10%). Only 34% consider the price for water too high or of bad quality (8%). Minor stated problems are issues with KSWC (2%); 22% mention that they have no problems at all with their connection.

Table 11 shows the results of the water quality tests in Kararie locality differentiated between Al Fateh, the not connected area, and the other survey regions. As expected there is no residual chlorine in the water of Al Fateh indicating that people consume either completely untreated water or water where all the chlorine was absorbed to eliminate pathogens in the water. The higher turbidity indicates that water in Al Fateh is more often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. This is confirmed by the E. coli indicator which shows that 53% of households in Al Fateh consume contaminated water but only 2% in the other survey regions. As WHO has a zero tolerance policy towards E. coli, we report whether E. coli is presented in drinking water or not. The results of the self-reported water quality in the survey in 2007 and 2014 show that in both periods 54 % of people connected to the piped system consider the water of very good or good quality. Whereas in 2007 48% of the surveyed population regarded the quality of water as insufficient, in 2014 23% consider the water sufficiently good and only 27% regard it insufficient. For those households purchasing water from vendors, 70% perceive the water as very good or good quality, 5% as of sufficient quality but 25% regard the water to be of bad (19%) or very bad quality (6%).

Table 11: Water Quality Indicators for Al Manara Catchment Area

	(1)	(2)	(3)
	Residual Chlorine	Turbidity	E. coli
2014 other survey areas	0.19	0.57	0.02
	(0.015)	(0.034)	(0.011)
2014 Al Fateh	0.00	1.08	0.53
	(0.000)	(0.318)	(0.125)
p-value difference other areas to Al Fateh 2014	0.000	0.114	0.000

Source: Household Surveys 2008 and 2014, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Sustainability

Financial: From a financial perspective, the main challenge is how AMWC can repay the loans because KSWC does not pay its water bills regularly and on time. Further the currency risk of the Euro denominated loans poses an enormous challenge because the water bill by AMWC is invoiced in Euro's while the revenues collected by KWSC are in the local currency (see also on the BOOT contract in chapter 8). Currently, the cash flow into AMWC mainly stems from the Ministry of Finance or Ministry of Infrastructure and Transportation rather than from the collected water bills. Fluctuations in the payment of bills from KSWC cause fluctuations in the repayment of the loan. The expectation that the loan will be repaid completely by 2020 is too optimistic also because at the moment of writing this report repayment of the principal even stopped. In response to the payment difficulties, the project lenders have provided the Khartoum State Government a waiver on the repayment of the loan principal. Therefore the Khartoum State Government is currently paying only the interest on the loans, and the operating and maintenance costs of the water treatment plant. There was a meeting in November 2014 between the lenders and the Khartoum State Government to review the payment situation and to seek a longer term solution to the payment difficulties. In response, the Khartoum State Government is currently looking into a number of options to refinance or buyout the project. This will be developed over the coming months (November 2014 and afterwards) by the Khartoum State Government and reviewed by the lending banks.

An additional problem causing a threat to financial sustainability is the flat rate payment scheme of private households because water tariffs have not been adjusted since many years. Prices for goods and services have gone up by 40% since 2008, salaries increased by 50%, but water tariffs have remained at the low initial level. As a result the share of expenditures on water in total household monthly expenditures have decreased, see Table 12. All activities undertaken by the plant managers or KSWC to increase the tariffs have failed because of political and consumer resistance. Another disadvantage of the flat rate system is that the consumption per payment class cannot be controlled, as water meters have not been installed at household level.

Table 12: Household Expenditures for Water in 2008 and 2014 via a Piped Connection

	Monthly expenditure on water	Total monthly expenditure	Share water in total expenditure	Households with a piped connection
2008	25.59 (0.905)	945.64 (91.087)	4.39 (0.202)	0.86 (0.011)
2014	25.77 (2.581)	4,858.50 (253.317)	1.06 (0.203)	0.92 (0.009)
p-value difference 2008 to 2014	0.947	0	0	0

Source: Household Surveys 2008 and 2014, *** p<0.01, ** p<0.05, * p<0.1

The installation of a household piped connection is paid by end users and differs by residential class between SDG 1 and SDG 4 per meter constructed between the household and the main pipe. Households in class 1 pay SDG 4 per meter for a 1 inch connection, class 2 households pay SDG 2 per meter for a ¾ inch connection, and class 3 households pay SDG 1 per meter for a ½ inch connection. Based on qualitative interviews in the area, people in Al Fateh report that it is a common practice for the so called "popular committees" (lowest administrative level responsible for social services in the neighbourhood) to increase the connection fees in an irregular manner to generate income for themselves. Many people mentioned that they have paid higher fees for new water connections but that they had no choice other than to accept these extra charges. This practice is considered by many people as a 'deal' between KSWC and the "popular committees". KSWC has delegated part of the work of establishing household connections to the "popular committees" so that they can collect the connection fees from one source. People at Al Fateh complained that these administrative arrangements are susceptible to corrupt practices and may disadvantage the poor at local level.

The flat rate water tariffs reported by households differ substantially from the official tariff scheme of KSWC, see Table 13. Households in the richest class (1) pay far less for water than they are supposed to do. In contrast, poorer, third class households pay on average the official tariff. Interestingly, the applied tariff scheme varies greatly over households while 18% of the surveyed households reported that they did not pay at all for water in the month before the survey was done. About 50% of the sample pays SDG 15, regardless of their residential class. Since 2012 the usual method of paying the water bill to KSWC is part of the combined pre-paid invoices for electricity and water. It seems that pre-paid payment is usually executed as 95% of households report paying the combined electricity and water bills. Only 5% of households report not paying through the combined system, probably because they do not pay at all.

Table 13: Actual and Official Water Tariffs

Class	Paid Tariff	Official Tariff
first	24.71	45
second	15.91	25
third	15.56	15
Observations	693	

Source: Household Survey 2014 and KSWC Sales Department, 2014

Box 6 summarizes an interesting discussion on water and paying for water of young scholars of Khartoum on Facebook. For the purpose of the research plan and design, on May 20th 2014, the following multiple choice questions were posted on the Facebook page of the local consultant in Sudan:

How do you pay your water bill?

1. *Directly to KSWC*
2. *Through a billing company:*
   A. Personally to the billing company
   B. Billing company collects it at home
3. *Others (specify)*

All participants agreed on the fact that the method of water fees collection currently practiced in Khartoum is the combination with the electricity bill. Since 2012, the water fees are collected in a pre-paid system, usually at the beginning of the month in combination with the electricity bill. This answer came from residents of different parts of the city and, so far, no indication of other billing methods practices came up.

The respondents reported that an amount of SDG 15 is charged to "traditional" houses while an amount of SDG 25 is charged to "modern houses". The amount is charged to every electricity meter and not per house, as one house can have more than one electricity meter because of multifamily houses. However the definition of traditional and modern houses is arbitrarily applied and not based on formal criteria as the size of the connection pipe.

Institutional: The water treatment plant is operated under a BOOT contract until 2020. During this period the management of the plant is in the hands of Biwater BV. In 2020 the plant will be fully transferred to KSWC. KSWC is often described as a weak institution, managed by senior staff clinging to their powers. The processes and communication within the institution are not transparent and pose clear threats to sustainability in general. During the time when Al Manara was planned and constructed, KSWC was run by a dedicated manager who introduced a new payment scheme and restructured the institution. However, this manager left KSWC (or was forced to leave) in 2008 and since then management and organization are constantly worsening. We did not receive data of KSWC for 2013 or earlier. KSWC only gave us access to data via personal interviews but did not make annual reports available.

Technical: Technically, Al Manara water treatment plant is considered the most advanced water treatment plant in Khartoum in terms of technology, laboratory and equipment. As financial means for planned maintenance are lacking, an obvious threat are unforeseen break downs. KSWC does not have financial reserves to pay for any planned or emergency repairs. Whether the ten year Operation and Management period will be sufficient to develop a "culture of maintenance" remains to be seen.

Under the terms of the BOOT Agreement it is intended that the staff of the AMWC will be transferred to the KSWC as a part of the transition of the facilities to the Khartoum State. In addition, during the final six months of operation by the AMWC, KSWC representatives will be given access to the facilities and to all documentation, in order to provide a smooth transfer to the Khartoum State. In practice, it is unlikely that all AMWC staff will be transferred, or indeed, that KSWC wants to employ all AMWC staff. Yet, the combination of staff who will transfer and the six months of working together with

KSWC, should not cause major obstacles to a successful transfer of the water treatment plant to the Khartoum State.

Ecological: Compared to the other water treatment plants operating in Khartoum, Al Manara water treatment plant is the soundest plant in Khartoum from an ecological point of view. It uses modern techniques and applies international standards for operating the plant and producing drinking water. As Biwater BV is still managing the plant, the hygienic standards are well maintained, i.e. concerning the sludge disposal.

Social: In the period 2009–2010, there were several demonstrations and efforts by the population of Greater Khartoum to resist the planned increase of water fees by KSWC. Contrary to the electricity meters, the installation of water meters has brought a lot of controversy among the wider population of Khartoum. KSWC has installed only a few of them in the business and industrial areas; however, it failed to install them in residential areas.

Water in Khartoum is a very sensitive issue. Especially, during summer season and Ramadan people get more agitated about water supply. Water service is of people's daily concerns. Moreover, people of Khartoum have a particular claim about the "right to water" that originates from the presence of two rivers in Khartoum, the White Nile and the Blue Nile. People often raise the question: how can residents of a city with such endowments still suffer a water crisis?

Box 6: Social Media on Water, a Facebook Discussion

In less than twenty four hours, the post had picked up great interest among Mrs Abdalla's Facebook friends who are mostly work/studies colleagues, friends, relatives and acquaintances. What was thought to be a simple question, turned into a heated political debate on Facebook. One respondent commented:

"The decision of the merger water with electricity caused waves of criticism and anger, especially among the poor population. Often, we find more than one family living in the same house, and each unit has separate electricity meters. By forcing each family to pay for water when buying the electricity, the cost of water has become too high. Moreover, the responsible body that estimates the amount required from each family does not have clear or fixed criteria."

The waves of criticism and anger triggered some people to complain about the government system and call for its withdrawal tasqot al-Ingaz (down with the government). Others prayed to God that "government officials may be burned with boiled water the way they are burning their citizens". This resentment is based on the fact that customers in Khartoum State now pay their water fee at the beginning of the month together with the electricity bill. However, the service is not consistent "it comes only few hours at night, we are deprived of sleep because we have to collect water in containers for the next day's consumption".

Especially during summer, water cuts are frequent. People have to find supplementary water sources such as water vendors even if they have already paid their fee at the beginning of the month. Here people mentioned the strikes that broke out in April 2014 in different parts of the city such as the Al Shajara neighbourhood in South Khartoum. Unfortunately, the strikes were struck down brutally by the police. Apparently, the water cut in this particular neighbourhood is believed to be caused primarily by corruption and a policy of favouritism. As it was explained, the main pipeline supplying Al Shajara area was sold by local authorities (administrative unit) to the richest part of the neighbourhood called Yathrib, where government officials and members of parliament resides, at the expense of poorer areas of the district. The governor of Khartoum, Abdalrahman El-Khidir, ordered the police to handle any water demonstration with force and declared "beat those people of al-Shajara until they find their way to the White Nile to fetch water". A few days later, several water tanks trucks were observed distributing water for free to people "only because the election is approaching!"

This new billing method is criticized for its inefficiency. Moreover, the staff is accused of performing a lot of technical mistakes so that often people end up paying their water bills twice to get their bills cleared. People also raised the concern about the ambiguity and unsettledness of water billing methods. People are not well informed to whom they actually pay their water bills. When the customers purchase electricity, they are uncertain whether they pay water bills to the electricity company, which is now a private company, or they pay it on behalf of the water corporation which is now private too, or whether these two companies are one entity now. Some people are of the opinion that everyone in government is corrupt but people have to pay their water bills and so far this new method has proved to be the best in obligating customers to pay their bills. One of the respondents argued that even if the water billing system is not consistent, people are committed to pay for the production cost, although water is available sometimes just for one hour per day.

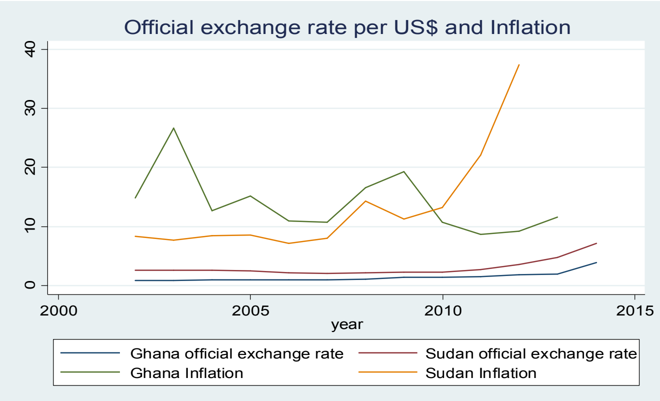
In this context, the following cartoon was posted in the discussion as demonstration of this argument.

It depicts Khartoum as a thirsty camel that carries two jars full of water on its back, yet it is visibly dehydrated. The two jars represent the White Nile and Blue Nile that run through the city and yet people cannot drink its water. The general message this cartoon sends is that despite the physical availability of water, with the presence of the two Niles, the mismanagement of this resource lead to the water crisis. The water mismanagement is connected directly to the inability of the government towards problem solving and corrupt practices.

8. Exogenous Shocks and Sustaining the Water Infrastructure

After a phase of partly privatizing the water market through assigning AVRL the management contract for operating water treatment plants, the government of Ghana is currently giving more attention to protecting poorer segments of their society from globalization. People active in the water sector report that this seems to be rather a tendency to hold on to political power than real attempts to improve the living conditions in Ghana. An increase of water tariffs is not planned in Ghana for the near future. There are no attempts to find a structural solution while GWCL builds up its deficit each year (see section 3.1.). However, the economic situation, and government finance in particular, does not allow for continuous debt financing of investments. The fiscal deficit reached 10.9% of GDP and public debt is close to 60% of GDP in 2013 (World Bank, 2014). The economic situation has worsened with the increased volatility in global financial markets since mid-2013 and a sharp decline in international commodity prices, among it the price of the recently discovered oil. In combination, these factors have led to a depreciation of the Ghanaian Cedi against the EURO since 2013 (see Figure 15). This depreciation makes the servicing of foreign loans, such as the commercial loans related to the ORET transactions, more difficult. These trends illustrate the difficulties governments face when they finance investments in a priority sector as the water sector with foreign loans. On the one hand there is the political pressure to stabilize the price for water whereas on the other hand the local currency component of the debt service is an increasing burden for the government budget.

Figure 15: Ghana and Sudan Exchange rate and Inflation



The Al Manara project faces similar problems that are however even more delicate given the political situation in the country. The project was planned at a relatively “peaceful” time in Sudan (2004 to 2006) when the Comprehensive Peace Agreement (CPA) was signed in 2005 between the government and southern groups. This process encouraged by the international community, ended decades of civil war in Sudan and resulted in the creation of South-Sudan. After decades of isolation from international involvement, lots of development projects flourished as a form of peace dividend in post-conflict Sudan at that time. However, the government of Sudan violated certain aspects of the CPA in recent years, to the extent of breaking the agreement several times after 2005. In July 2011, South Sudan declared its independence from the North. As oil production is situated in the south, the secession also lead to a complete stoppage of oil revenues to finance government expenditure. Therefore, the failure of KSWC to deliver its responsibilities cannot be seen in isolation from what is happening in the political system as a whole. An increase of the water tariffs is regarded as not possible from a political point of view even though the servicing of the debt is an increasing drain on the government budget. This dilemma is exacerbated even more since the BOOT contract requires that KSWC pays tariffs for the water consumption and the loan in EUROs.

The BOOT agreement in Sudan was signed in December 2006 when the Euro SDG exchange rate was around 2.7. Since then the currency rate has been falling to a level of 7.1 today. Consequential, KSWC and the Khartoum State Ministry of Finance face increasing difficulties to service their loans denominated in foreign currencies. As the exchange rate tripled during the last years, so did the local currency equivalent of the loan. It was important for KSWC to establish the distribution network (which was not within the scope of this project) and connect new customers to increase demand for the water produced by Al Manara and thereby enhance revenue. However, this did not happen, primarily because the flat rate tariff system was not adjusted and water meters were not introduced causing overconsumption and serious shortfall in much needed revenue. There has been some improvement in the supply to some of KSWC's existing customers but that does not produce (sufficient) new revenues to KSWC.

In both countries, Ghana and Sudan, the water tariff system is not designed to cover the cost of the capital investments in water related infrastructure nor pay for the maintenance and replacement of machinery. The current tariff system hardly suffices to pay for operation and temporary maintenance costs and therefore needs to be adjusted to achieve long-term financial sustainability of water infrastructure investment. A good start would be to introduce water meters, adapt consumption adjusted systems to stimulate customers to economize on their consumption and collect the water bills from every consumer, especially the wealthy ones. Both in Sudan and Ghana, the poorest pay the highest price for their daily water consumption which is literally a cash and carry business.

9. Relevance, Additionality and Coherence

9.1 Relevance

As investment in water infrastructure goes in line with the achievement of Millennium Development Goal (MDG) 7c of reducing by half the population without access to improved drinking water and sanitation. The ORET projects in water infrastructure were therefore most relevant for human development in both Ghana and Sudan.

Since 2003 Ghana follows the Ghana Poverty Reduction Strategy (GPRS) where increasing access to water is one of the key priorities. According to the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, Ghana met the MDG target on access to drinking water by increasing the proportion of the served population from 54% in 1990 to 87% in 2012. This means an increase by 33% points of the population or an increase by 61%.

In the case of Sudan, besides that investment in water infrastructure is of greatest importance because of the impact on public health outcomes, adequate water supply is also most relevant for political stability. According to the National Five-year Plan (2012 - 2016) published in March 2012, water management is still a priority and considered to be one of the key elements of the government policy in the socio-economic sector, particularly in the field of social development and health[7]. Clean drinking water should be made available to the population in all states.

9.2 Additionality

Without the ORET grants in Ghana probably none of the projects would have been funded in a similar way. Because ORET provided a 53% grant component this was favourable for GWCL. The attractive funding conditions under the Water Facility within ORET and the available funds made ORET the main funder of drinking water projects in Ghana. An alternative source could have been the World Bank loan of USD 103 million in 2005, under which also the Aqua Vitens Rand management contract for GWCL was financed. It is uncertain whether the same number of water projects would have been funded. Most probably, some transactions would have been realised but it is uncertain that other donors would have offered similar conditions. Ghana would have been obliged to fund a larger part with commercial loans. As an example, for the Barakese water treatment plant in Kumasi an additional investment of 12.5 million EURO was financed in 2010 by a 100% commercial loan. This illustrates that it was possible for GWCL to find other financial means but at higher cost.

Without the ORET grant, the Al Manara project would not have been realized because it was crucial in the overall financing structure of AMWC and due to unavailability of funding at KSWC. ORET provided a 55% grant component which was favourable for AMWC. It allowed KSWC to pay lower tariffs for the water produced by the water treatment plant and hence charge lower prices to end-users. The attractive financing conditions and the establishment of AMWC for management and operation both contributed highly to increased water supply in Greater Khartoum. As Al Manara water treatment plant provides 24% of water supply to Greater Khartoum, the ORET programme contributed significantly to improvement of the access to drinking water in the area.

[7] Republic of Sudan, Ministry of Presidential Affairs, the Secretariat General of the National Council for Strategic Planning, the National Five-year Plan (2012 - 2016), p. 26.

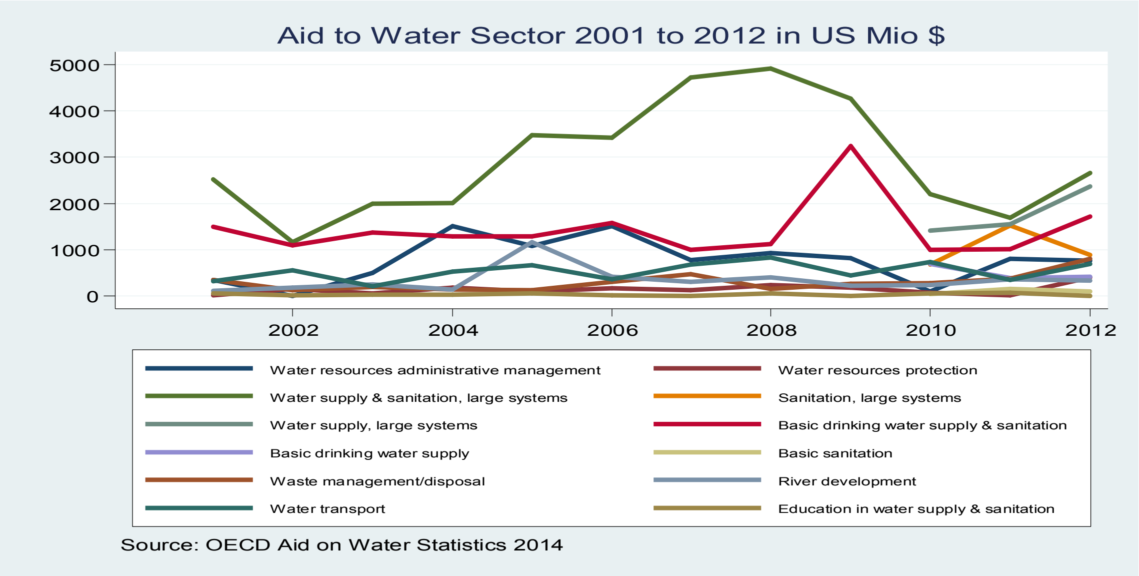
9.3 Coherence

According to the Ghanaian Ministry of Water Resources and Housing, water supply infrastructure is a key government policy. The Government's target is to reach 85% urban water coverage and 76% rural coverage by 2015 according to the Strategic Water Development Plan.

In Sudan, according to the National Five-year Plan (2012–2016) that was published in March 2012, water management is still of greatest concern. According to this document, clean drinking water should be made available for the population in all the states. This is considered one of the key elements of the government policy, particularly in the field of social and health sector[8].

Therefore the transaction and projects in the water sector of the ORET programme in Ghana and Sudan can be considered as highly consistent with the policies and strategies of the recipient countries and with the policies of the Netherlands.

Figure 16: Total Donor Aid to the Water Sector



OECD estimates show that aid to water and sanitation programmes has increased sharply in absolute terms in the last decade but is currently declining. For DAC countries, the share of aid to the water sector has increased by one percentage point over the period between 2003 and 2008, from 6% in 2003–2004 to 7% in 2007–2008 (OECD/DAC, 2010). Much of this aid is used for large water infrastructure projects and basic water infrastructure as village-level water points, e.g. public standpipes or pumps, a form of access found often in low-income countries, see Figure 16. This contributes toward the MDG 7 of increasing access to improved drinking water sources. These investments are often justified in terms of improved health, particularly in reduced diarrheal incidence for children under the age of five (Hutton et al., 2006).

The Netherlands contributed considerably to aid in the water sector globally. In the period 2006–2007 it made commitments of US$ 392 million in the water sector, which is about 11% of the total Dutch aid and amounts to 6% of total allocable aid in water and sanitation worldwide (OECD, 2008).

[8] Republic of Sudan, Ministry of Presidential Affairs, the Secretariat General of the National Council for Strategic Planning, the National Five-year Plan (2012 - 2016), p. 26.

10. Main Findings and Recommendations

10.1. Main Findings

- In three of the four water treatment plants evaluated, the water production is according to the designed qualitative and quantitative standards. The fourth water treatment plant in Kwanyaku is producing only at 2/3 of its potential because it was intentionally over-dimensioned to meet future demand.

- The water treatment plants evaluated produce between 60 to 90% of the designed capacity with frequent power cuts and problems in the transmission systems as the main causes for not realising full potential.

- Certain steps in the production process in the water treatment plant in Tamale are not used anymore because of breakdowns and lacking funds for repairs. The plant still produces water but with an improvised system.

- The Kwanyaku water treatment plant would face a lack of competent staff to operate and maintain the plant if the contractor Denys would not provide ongoing support. There is no structural solution in sight for this problem.

- The Barakese water treatment plant would have functioned more optimally if the transmission systems would have been strengthened in parallel, e.g. in a follow-up transaction.

- Technical sustainability of the water supply systems is under threat because of a poor maintenance culture within the Ghanaian water treatment plants, frequent electricity outages and inadequate management of spare parts.

- A BOOT design with a lengthy transition period like in Al Manara is favourable because of the development of a *culture of maintenance.* It is expected that this culture will be continued if the current AMWC staff will be transferred (at least partly) to the local partner who will be fully responsible after 2020.

- Most of the problems facing the water plants are at the institutional level of the national water authorities: delays in ordering and delivery of spare parts and chemical inputs, poor communication between the water treatment plants and national water authorities and continuous budgets problems to finance recurrent cost for the operation of the water plants.

- Water quality standards are nevertheless maintained, albeit sometimes in an improvised manner, and good quality drinking water arrives at the household level through piped connections (in Sudan) and at standpipe level (in Ghana).

- For the poor, getting clean drinking water is literally a cash and carry activity, if they can afford it with unreliable water from traditional sources as the fall-back with its concomitant health risks. They pay the highest price per m^3 for drinking water at the standpipes compared to households that have a piped connection to the house but where water meters are often missing. Big users (rich people and hotels) also pay a flat rate tariff, lack incentives to economize on water consumption and hence use large amounts of water.

- The unit price of water sold at private standpipes is about 16% higher than water at public standpipes but private standpipes are better managed and face less down time in case of technical problems.

- In the case of Kwanyaku, 35% of the public standpipes constructed by the ORET-projects are not working any more. The most important reason for the complete shutdown of standpipes was the problem of non-regular payment of the water bill to GWCL which was related to the way the water vending and management of the standpipe was organized. The second reason was that almost half of the non-operating standpipes have never been connected to the system.

- The public ownership of standpipes in Ghana has been less efficient and transparent in practice because the responsibilities of Water Committees to manage water revenues and standpipes were not clearly defined nor was accountability for the use of revenues enforced. Consequently, regular payment of the water bills was less likely resulting in shut downs of a relatively large number of standpipes. Privately-managed systems seem to offer better incentives for the individual water vendor/investor to provide a superior service delivery though at a slightly higher price for consumers.

- The flat rate tariff system for end-users in Ghana and Sudan does not provide for cost recovery although it was intended to do so and be administratively simpler. This price system sets the wrong incentives for water consumption, especially if water meters are not installed and water bills not consistently collected. It makes it impossible to make clear statements about the water produced and the water sold and therefore difficult for water authorities to address the high level of unaccounted for water which jeopardizes the future of the water systems.

- While ORET offered an attractive grant percentage for the water plant transactions in Ghana, the one-off cost of the non-grant financing in terms of bank fees and insurance premium for the credit risk came at a relatively high price. The variance in the one-off cost of the non-grant finance, varying from 11.5% to 20.7%, cannot be explained by differences in the credit risk of the transactions, the end-user, the country or the period because they were the same or similar.

- While the BOOT contract for AMWC offered the benefit of a huge investment and little capital outlays upfront for the end user KWSC, it has not provided a magic solution because of some basic flaws in the financial design. Important financial risks were either pushed to the future or the end-user or ignored. The most important problem is the currency mismatch between on the one hand the Euro denominated loans and the water tariffs that KWSC pays to AMWC (in particular the capacity charge) and on the other hand the intended repayments from water revenues in local currency of newly connected customers. Another problem is that AMWC has no control over the number of newly connected customers and the water tariffs while their product in the form of water revenues forms a critical element in the repayment model. It is doubtful whether this type of innovative financing structure can be replicated in similar difficult local circumstances.

10.2. Recommendations for an ORET Successor Programme

Recognizing the limited leverage that even a large donor can have over politically sensitive policy issues (vide the World Bank experience with the outsourced management of GWCL by AVRL), the following recommendations are made for water transactions to be financed by a possible successor programme of ORET.

- Introduce longer periods of TMA (Technical Maintenance Assistance) and WAM (Water Asset Management) in the projects before the water treatment plant is handed over to national water authorities to develop a culture of maintenance.

- Take full account of bottlenecks in the distribution systems of the water plants and integrate solutions to these problems in drinking water projects.

- Promote a standardization process for spare parts and other materials to make repairs and maintenance less problematic.

- Stimulate the installation of water meters and collection of water bills across the board. This would generate much needed revenue for every m^3 of water produced and reduce the high levels of non-revenue water (NRW).

- Insist on the revision of tariff systems. Flat rate tariff rates are not appropriate and increase the NRW-problem of water institutions.
- Consider interventions at the administrative level of national water institutions towards improved organization and management of the institutions.
- Organize the vending of water from public standpipes to end-users privately.
- Include training of water vendors in technical and maintenance issues and basic accounting.

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Annexes

A1: Research team and interview partners during the evaluation in Ghana and Sudan

The Research Team:

A1a Persons carrying out the evaluation on Ghana:

1. Dr. Elena Gross - Principal Investigator
2. Dr. Bernardin Senadza - Local consultant
3. Louis Sitsofe Hodey Research assistant

The following persons carried out the evaluation on Sudan:

1. Dr. Elena Gross - Principal Investigator
2. Salma Abdalla Local consultant

A1b Persons/Stakeholders interviewed in Ghana:

1. The DENYS Team comprising of Wouter Gezelle (Ghana Project Manager) and Mathieu Griselain (successor Wouter Gezelle), and Andry Marangos (Technical Maintenance Manager)
2. The Biwater Team comprising Ryan Murphy (Project Manager), David Robinson (Project Manager) and Giles Jackson (Director)
3. The Ballast Nedam Team comprising Adri Verweij**,** Area Manager and Jeff Pinkney, Manager Operations – Ghana.
4. Head Office GWCL: Mr. Kwaku Godwin Dovlo, Managing Director, Mr. Fred Lokko,Chief Manager Project Planning and Development, Mr. Cephas T. Oguah, Chief Manager, Corporate Planning & Business Development
5. Regional Manager GWCL Tamale, Kumasi and Cape Coast
6. Station Managers, Kwanyaku Water Treatment Plant, Barakese Water Treatment Plant and Tamale Water Treatment Plant
7. Water vendors from Kwanyaku, Tamale and Kumasi water supply systems
8. End-users from Kwanyaku, Tamale and Kumasi water supply systems

A1c Persons/Stakeholders interviewed in Sudan:

1. The Al Manara Water Company Team: Mr. John Philidius (Project Manager), Mr. Abdel Hameed El Sir (Production Manager), and Mrs. Rowida Abdel Azim Mahjob (Laboratory Supervisor)

2. Biwater: Ryan Murphy (project Manager) and Giles Jackson (Managing Director)
3. Interview of Mangers at FMO on 6th of March. Findings: Al Manara is currently working at a 85 percent production level (170 000m^3), loans are not paid back by KSWC
4. FMO: Geert Monster and Robert Voskuilen
5. Khartoum State Minister of Infrastructures and Transportation: Dr. Ahmed Gasim Mahmoud (Minister); Mr. Hisham Ali Ahmed Abuzaid (Foreign Affairs and Coordination Manager).
6. Khartoum State Water Corporation KSWC: Eng. Godat Alla Osman Suliman (General Manager); Eng. Ahmed Hassan (Manager of Water Resources and Production); Eng. Elsadig Gismallah (Technical Officer at Water Resources and Production Department); Mr. Mahgoub Mohammed Taha Edrees (Technical Advisor); Mr. Huziefa Elshaikh Hussein Ahmed (Financial Manager KSWC).
7. Omdurman Locality Water Offices: Eng. Zaki Osman (General Manager Ombbada Water Office); Eng. Abdalmunim Abdalhai (General Manager Kararie Locality Water office); Eng. Hisham (Engineering and Maintenance Manager, Kararie Water Office).

A2: Questionnaire Guideline

Headquarter

1. Meeting date/Time:
2. Contact Person:
3. Organization Chart
4. Communication with local offices
5. Support of local offices
6. Financially?
7. Technically?

GWCL LOCAL (Northern, Ashanti and Central region)

1. Meeting date/Time:
2. Contact Person
3. Organization Chart
4. Communication with headquarter GWCL
5. Support from headquarter GWCL
6. Financially?
7. Technically?
8. How is water vending organized?
9. Payment of people who are involved in water vending?
10. How much do end-users have to pay for water?
11. Revenue of water sales to GWCL
12. Management of revenues
13. Unaccounted for water
14. Payments for maintenance
15. Payments for repairs
16. Water Quality Indicators

Water Treatment Plants Kwanaku, Barakese, Tamale, Al Manara

1. Meeting date/Time:
2. Contact Person:
3. Organizational Chart
4. Current production capacity of the plant
5. How many water points are served?
6. Number of households connected/ individuals served
7. Number of hours that water is available to households
8. Amount of m^3 sold
9. Amount unaccounted for water
10. Technical indicators: km of pipes constructed, water pressure, water quality before water enters/after water leaves the piped system

Semi-structure questionnaire local water responsible/delegate/water committee

1. Meeting date/Time:
2. Contact Person:
3. Organizational structure of water vending
4. Who collects water?
5. Do water collectors immediately pay, pay later, payment rates, flat rates?
6. Who really pays for water?
7. How much do end-users have to pay for water?
8. What is done with the collected money?

9. How much does delegate earn for collecting water fees?
10. Contacts for repairs and maintenance?
11. How much did the last reparation cost? How long the water point was broke? Did the collected funds have been sufficient for repairing the water source? Who else paid for repairing?
12. Is part of the money given to GWCL? How much? When collected?

Semi-structured questionnaires end-users

1. How much do you pay for one recipient of water (usually 30-40 liters)
2. When is the water source open for water purchasing?
3. Do you pay per recipient/week/months/flat rate?
4. How many water sources do you use? What types of sources? Modern and traditional for different purposes?
5. Is water from different sources mixed?
6. Transport/storage of water in households?

A3: Data requested from national water authorities (GWCL and KSWC)

- Organization Chart
- How many employees does the regional water authority have?
    - Technical
    - Administrative
    - Meter readers/Bill collectors?
- Organization Chart Water Treatment Plan
- Annual Financial Reports since 2007
- Annual Technical Reports since 2007
- Revenue of water sales to water authority
- Profit/Losses 2007-2013
- Payments for maintenance
- Payments for repairs
- How many water points are available to the population which are served by the treatment plant?
- How many of these water points are publicly run/privately run? I.E. where is the name on the bill for a standpipe a private person? Where the name on the bill is a Unit Committee/ Water Committee
- How many household connections
- Number of individuals served total
- Number of governmental connections
- Number of commercial connections (e.g. hotels)
- Estimated amount unaccounted for water in region
- Amount of m^3 sold
- Water quality at standpipes:
    - How often is water quality checked?
    - Which indicators are taken?
    - If the water quality is found to be bad, what is done?
    - What is the origin of the contamination?
- How much do end-users have to pay for water?
    - Households with private connections per m^3
    - At standpipes per m^3
- Customer survey if available

Indicators from water treatment plant

- Current production of the plant
- Water quality indicators
- Annual Financial Reports since 2007
- Annual Technical Reports since 2007

A4: Questionnaire Water Vendors Ghana[9]

SECTION 1

q1	Code of Enumerator	
sqno	To match with census	
ln	To match with census	
district		
sn	To match with census	
q1a	Name of village	
q2	Date of Interview	
q4	Water source number	
q5	GPS Coordinates	q5a Latitude
		q5b Longitude
q6	Name of respondent	
q7	Age of respondent (in years)	
q8	Education of respondent	

1	None
2	Kindergarten
3	Primary
4	Middle
5	JSS
6	SSS
7	Voc/Comm.
8	Sec (O Level)
9	Sec (A Level)
10	Technical
11	P/Sec. T/T

[9] The questionnaire was programmed in CSPro and entered into netbooks directly in the field.

12	Nursing
13	P/Sec. Nursing
14	Polytechnic
15	University
16	Koranic

q9 What is the sex of the respondent

1	Male
2	Female

q10 Type of public water source:

1	Private household connection sells water
2	Standpipe Denys
3	Other standpipe connected to system
4	Private houseold selling water at borehole standpipe
5	Public standpipe borehole
6	Other...

q10a Other specif Q10

10b Is water source connected to a storage tank?

1	Yes	**Skip to Q11**
2	No	

q10c What type of storage tank?

1	Citerne cement
2	Polytank
3	Other specify ...

q10d Other specify?

q10d Storage capacity in liter?

Lit	

q10e Do you also store rain or truck water in there?

1	No
2	Yes, both
3	Yes, but rain water only
4	Yes, but truck water only

q11 Who constructed the water source?

1	NGO
2	GWCL
3	Private/Own construction
4	Community
5	Church
6	DENYs
7	don't know
8	Other specify

q11a Other specify from q11 ____________________

q12 The water source is:

1	Privately owned, privately operated	
2	Publicly owned, privately operated	
3	Publicly owned, publicly operated	
4	Not operated/running any more	**Skip to Section 2**
5	Other, specify:	

q12a Other specify from q12 ____________________

q13 Status of respondent

1	Operator of water source
2	Agent of Unit-Committee/Assembly Man

	3	Standpipe manager
	4	Employee
	5	Family member
	6	Other, specify:

q14	Is respondent of the interview also the owner/responsible operator?	1	Yes	**SKIP to Q19**
		2	No	**Proceed with Q15**

q15 Name of owner/responsible operator

q16 Age of owner/responsible operator (in years)

q17	Education of owner/operator	1	None
		2	Kindergarten
		3	Primary
		4	Middle
		5	JSS
		6	SSS
		7	Voc/Comm.
		8	Sec (o Level)
		9	Sec (A Level)
		10	Technical
		11	P/Sec. T/T
		12	Nursing
		13	P/Sec. Nursing
		14	Polytechnic
		15	University
		16	Koranic
		17	Other, Specify

q18	What is the sex of the owner/operator	1	Male
		2	Female

q19	How did owner/responsible operator acquire possession of the water source?	1	Assigned by Assembly Man/ Unit Committee
		2	Assigned by Water Committee
		3	Paid accumulated bills/debts to GWCL
		4	Bought the water source from GWCL
		5	Neighbours paid for bills (Collective)
		6	Personally constructed water source
		7	Contacted by Denys and registered at GWCL
		8	Bought the water source from somebody
		9	Don't know
		10	Other (specify)…………………………………….……...

q19a Other specify from q19 ______________________________

q19b How much did you pay for the connection/water source/cost of construction? GHS ______________________________

q19c_1 Cost GWCL: GHS ______________________________

q19_c2 Cost Construction GHS ______________________________

Date Month Year

q20a	Since when has the water source been in operation? (88=Don't know)			
q20b	Since when has the current owner/responsible operator been managing the water source? (88=Don't know)			
		If equal to start of standpipe operation skip to Q22		

q21	Who operated water source before owner/responsible operator acquired it?	1	Other family in the village	
		2	Water Commitee	
		3	Other family member	
		4	Don't know	
		5	Other (specify) …………………	

q21a Other specify from Q21 ______________________

q22	How do you usually communicate with GWCL	1	Direct face to face
		2	Via phone
		3	Via Assembly Man
		4	Via Unit Committee member
		5	Never communicated with GWCL
		6	Via other person

q23	Where do you get technical assistance in times of breakdowns	1	GWCL
		2	Local technician
		3	Technician from nearby larger town
		4	Other (specify) ………………………………….

q23a Other specify from Q23 ______________________

q24	How responsive is the technician to your request for technical assistance during breakdowns?	1	Very prompt	
		2	Slow	
		3	Very slow	

q24	How responsive is GWCL to your request for technical assistance during breakdowns?	1	Very prompt	
		2	Slow	
		3	Very slow	

q25	Is a meter installed at the water source?	1	Yes	
		2	No	**Skip to Q28**

q26	Is the meter working?	1	Yes	
		2	No	**Skip to Q29**

q27	Value on the meter		

q28	Why don't you have a meter installed?	1	GWCL short of meters
		2	No meter installed since water source was built
		3	Previous meter removed because faulty
		4	Don't know
		5	Other (specify) …………………………………….

q28a Other specify from Q28 ________________

q29	How much did the last repairs cost?	GHS

q30	How long was the water point out of order the last time?		Days	
q31	What was the fault?		Specify:	
	DK = for Don't know			
q32	How much was payment for maintenance in the last 6 month		GHS	**Write 000 for true zero**
q33	How much was payment for repairs in the last 6 month		GHS	**Write 000 for true zero**
q34	Did you have sufficient available funds for repairing the water source the last time?	1	Yes	**Skip to Q37**
		2	No	
q35	Who else assisted in paying for the cost of repairs?	1	Nobody	
		2	Neighbors	**Skip to Q37**
		3	Village	**Skip to Q37**
		4	Relative	**Skip to Q37**
		5	Other, specify	**Skip to Q37**
Q35a	Other specify from q35		________________	
q36	How were you able to pay for the remainder of the repair cost?	1	Credit	
		2	Lend money from somebody on the village	
		3	GWCL paid for it in the end	
		4	My insurance paid for it	
		5	Water Committee paid it	

6	Other, specify	

q36a Other specify from Q36 ______________________

q37 Do you regularly receive water bills from the GWCL?

1	Yes, regularly	
2	More or less regularly	
3	Seldom	
4	Never	**SKIP to Q42**

q38 How much was the water bill in: (8888 if Don't know)
GHS
Amount m³

GHS
Amount m³

	March	April
	May	June

q39 What remains as debt owed to GWCL after the last bill

(information is on GWCL bill)

GHS		**Put zero if no debt remains**

q40 Who pays the water bill

1	Water source owner/Responsible operator
2	Unit-Committee/Assembly Man
3	Water Committee

q41 When was water bill received the last time?
88=Don't know

Date	Month

q42 Number of households collecting water at this water source: No. ______
q43 Amount of revnues per day: No. ______

q44	Number of hours that water is available at water source within one day (24 hours)? (opening hours)	No.	

q45	In which months was the water turned ***(!!not break down!!)*** off the last time?	1	January
		2	Febuary
		3	March
		4	April
		5	May
		6	June
		7	July
		8	Never

q46	How many hours was water turned off the last time? **Comment: 1 day=24h, 2days=48h, 3 days=72hours, 4 days=96 hours, 5 days=120 hours, 6 days=144 hours, 7 days=168 hours**	Hours

q47	What problems do you have with the water source? **(Multiple responses allowed)**	1	No problem	Repairs	6
		2	No water	Paying bills	7
		3	Low pressure/Water is trickling	Management	8
		4	Bad taste	GWCL	9
		5	Bad water quality	Problems with clients	10

q48	Do end-users pay for water at the water source?	1	Yes	
		2	No	**SKIP to Q54**

q49 How much do households/end-users have to pay for water?

1	Bucket 34l		GH P
2	45l Gallon		GH P

q49a Who sets the price for selling water?

1 Own price calculation
2 GWCL
3 Community/District management
4 PURC- Public Utility Regulatory Commission
5 Law
6 Water Committee
7 Unit Committee
8 Customers
9 Defined by population of the village
10 Other specify……

Q49b Other Specify from Q49A

____

q50 How do people pay for water fetched from the water source?

1	Immediately per bucket **go to q52**
2	Pay once a day for all buckets **go to q52**
3	Pay once a month **go to q51**
4	Flat rate **go to q51**
5	Money is collected when water bill arrives **go to q52**

q51 Amount monthly/flat rate:

GHS	

q52	Who collects payment for water from end users at the water source?	1	Owner/Responsible operator
		2	Household head Male
		3	Household head Female
		4	Spouse Male
		5	Spouse Female
		6	Family member
		7	Near family
		8	Employee
		9	Anyone in household

q53	How often per month do you allow people to fetch water for free?	Number		**Skip to q55 if equal to 0**

q54	Why can people collect water for free?	1	They have no money
		2	We exchange goods
		3	Favor
		4	Other, specify

q54a Other specify fro q54

q55	How often was the water tested for water quality during the last year?	1	Regularly
		2	Never

3	Once before
4	Twice before
5	Three times before
6	More than three times

q56 How much was the total cost of the water source in the last months?

Self-reported!

	GHS	

q56a How much were total sales revenues of the water source last months?

Self-reported!

	GHS

Q57 Do you share your profit (losses) with another person/group?

1	Yes	
2	No	END OF INTERVIEW

Q58 With whom do you share the profit?

1	GWCL
2	Unit committee
3	Water committee
4	Other, specify

Q58 Other specify from Q58

____

Q59 Sharing rate

%	Operator/Owner
%	Other
	Fixed Amount

q57 Telephone number for contact

____

SECTION 2

q58	Status of respondent	1	Former standpipe owner	
		2	Former standpipe operator	
		3	Agent of Unit-Committee/Assembly Man	
		4	Former standpipe manager	
		5	Employee	
		6	Family member	
		7	Inhabitant of village	
q59	The water source was:	1	Privately owned, privately operated	
		2	Publicly owned, privately operated	
		3	Publicly owned, publicly operated	
q60	Why is standpipe not working			
		1	Broken down/faulty	**Skip to Q61**
		2	Disconnected by GWCL	**Skip to Q62**
		3	Other (specify) ………………………..	
Q60a	Other specify Q60			
q61	What is the nature of breakdown/fault?	1	Tap	**Skip to Q62**
		2	Pipe to main line broken	
		3	Pipe within standpipe system broken	
		4	Other (specify) ………………………..	
q62	Water disconnected by GWCL	1	Because bill was not paid	
		2	Conflict within village about management of standpipe	
		3	Problems with GWCL	
		4	Problems with Water Comittee	
		5	Other (specify) ………………………..	

q62a Other specify from Q59

q63 Since when is source not operating

Month	
Year	

q64 Telephone number for contact ______________________

A5: Questionnaire Household Survey

ORET EVLUATION - AL MANARA OMDURMAN- 2014

q1	Enumerator Code		________
q2	Residential area		________
q3	Residential area code (see list)		________
q4	Household Number		________
q5	Residential Class		________
q6	Date of Interview		________
q7	Name of Respondent		________
q8	Age of Respondent		
q9	Sex of Respondent	1	Male
		2	Female
q10	Telephone for contact	No.	________
q11	Role of respondent in the household	1	Household head
		2	Spouse/Husband
	ONLY ONE ANSWER	3	Daughter/Son
		4	Granddaughter/Grandson
		5	Mother/Father
		6	Brother/Sister
		7	Other family member
q12	How many persons do live in the household?	No.	
q13	How many children below the age of five do live in the household?	No.	
q14	How many of the children suffered from diarrhea during the last week?	No.	
q15	Did any of the children see a doctor/go to hospital?	1	Yes
		2	No
q16	Type of latrine used in household	1	Siphon/Flush Toilet
		2	Ventilated Improved Pit Latrine
	ONLY ONE ANSWER	3	Unventilated latrine
		4	Public Latrine
		5	No latrine

q17 Main water source:

ONLY ONE ANSWER

1	Tap inside the house
2	Tap water from neighbor
3	Tap outside the House
4	Protected Well inside Hai
5	Unprotected Well inside Hai
6	Donkey Card Water Vendor
7	Tanker
8	Other Specify

q17a Other specify from Q17 ______________________

q18 Do you have a water tank to store water:

1	Yes
2	**No Skip to q21**

q19 What is the tank's capacity:

ONLY ONE ANSWER, take largest if multiple tankers

1	1 barrel
2	2-3 barrels
3	4-5 barrels
4	More than 5 barrels

q20 Type of tank:

ONLY ONE ANSWER

1	Underground
2	On the ground
3	On a stand
4	On the roof

q21 Do you store water in the house?

1	Yes
2	**No Skip to q23**

q22 Is the recipient covered?

1	Yes
2	No

q23 What are the three most serious problems regarding water supply in your area?

q23_1

FIRST ANSWER

1	Lack of a water network
2	Frequent cuts of supply
3	disruptions during summer
4	Inadequate and weak flow
5	High cost of water
6	Bad water quality
7	KSWC

	8	**No problem (skip to Q24)**
q23_2	1	Lack of a water network
	2	Frequent cuts of supply
SECOND ASWER	3	disruptions during summer
	4	Inadequate and weak flow
	5	High cost of water
	6	Bad water quality
	7	KSWC
	8	**No 2nd problem (skip to q24)**
q23_3	1	Lack of a water network
	2	Frequent cuts of supply
THIRD ANSWER	3	disruptions during summer
	4	Inadequate and weak flow
	5	High cost of water
	6	Bad water quality
	7	KSWC
	8	No 3rd Problem

q24 How do you find the supply during the last month?

1	Good
2	Stable
3	Weak
4	No supply

q25 How do you find water supply in the winter?

1	Good
2	Stable
3	Weak
4	No supply

q26 How do you find the quality of water during the last months?

1	Very Good
2	Good
3	Sufficient
4	Bad
5	Very Bad

q27 How do you find the quality of water during the winter?

1	Very Good
2	Good
3	Sufficient
4	Bad

5	Very Bad

Q28 **Household Expenditure:**

No	Item		
1	Food (in home and outside) and drinking **(last 7 days)**	SDG	
2	Rent **(last month)**	SDG	
3	Electricity **(last month)**	SDG	
4	Water **(last month)**	SDG	
5	Taxes, Fees, Dues **(last month)**	SDG	
6	Clothing **(last year)**	SDG	
7	Education **(last month)**	SDG	
8	Health **(last month)**	SDG	
9	Religous Cerimonies **(last month)**	SDG	
10	Transport (Fuel and Public) **(last month)**	SDG	

q29 Is household connected to the piped system?

1	Yes
2	**No Skip to Section 2**

q30 Since when are you connected to the piped system

Month	Year

q31 How much did you pay for the connection? SDG ________

q32 How much did you pay for water last months? SDG ________

q33 How many barrel/jerry cans/m³ of water did you buy last month? Barrel ________

Indicate in Barrel or Jerry cans or m³ **or** Jerry cans ________

ONLY ONE ANSWER! **or** m³ ________

q34 Do you pay electricity and water bill together (pre-paid system)?

1	Yes
2	No

q35 Do you additionally buy water from vendors (Donkey carts):

1	Yes

	2	No **(Skip to Q42)**

q36	How frequent do you buy water from vendors:	1	Always
		2	Sometimes
		3	Rarely

q37	How much water did you buy from vendors during the last week	1	1 barrel
		2	2-3 barrels
		3	4-5 barrels
		4	More than 5 barrels
		5	Nothing

q38	Do you know the water source where water vendor collects water?	1	Yes
		2	**No Skip to Q40**

q39	From which water source is this water?	1	Household with connection
		2	Public standpipe
		3	Water Kiosk
		4	Open well
		5	Protected Well
		6	River
		7	Water Reservoir

q40 How much is the cost per jerry can: SDG ____________________

q41	How do you find the quality of water from water vendor?	1	Very Good
		2	Good
		3	Sufficient
		4	Bad
		5	Very Bad

q42	During the last week, did you receive all water you need from any source?	1	Yes (End of Interview)
		2	No

q43	Why did you do not receive all water you need?	1	Lack of financal means
		2	Lack of storage
		3	Not sufficient water available

SECTION 2

q44	How do you get water to your house?	1	Donkey Cards
		2	Truck
		3	Member of the household fetches water
		4	Non-member of the household fetches water

q45	From which water source is this water?	1	Household with connection
		2	Public standpipe
		3	Water Kiosk
		4	Open well
		5	Protected Well
		6	River
		7	Water Reservoir
		8	Don't know

q46	How much is the cost per jerry can:	SDG	

q47	How do you find the quality of water?	1	Very Good
		2	Good
		3	Sufficient
		4	Bad
		5	Very Bad

q48	How much did you pay for water last week	SDG

q49	How much water did you buy from vendors during the last week:		Barrel
		or	Jerry cans
	Indicate in Barrel or Jerry cans or m³ **ONLY ONE ANSWER!**	or	m³

q50	During the last week, did you receive all water you need from	1	Yes

	any source?		
		2	No
q51	Why did you do not receive all the water you need?	1	Lack of financal means
		2	Lack of storage
		3	Not sufficient water available
		4	Water vendor did not come
q52	Do you buy water from multiple vendors (Donkey carts):	1	Yes
		2	No
q53	How frequent:	1	Always
		2	Sometimes
		3	Rarely
q54	How many different water vendors do you have?	No.	
q55	Why are you not connected to the system?	1	Lack of financial means
		2	Construction does not advance
		3	Problems with KSWC
		4	Impossible in myy area
q56	Would you like to be connected to the piped system?	1	Yes
		2	No (END OF INTERVIEW)
q57	Why not?	1	more expensive
		2	less expensive
		3	Water is cleaner
		4	Continous supply
		5	Less effort
q58	How much would you be willing to pay for piped connection?	SDG	______________________