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**DELIVERING WATER, SANITATION AND HYGIENE SERVICES
IN AN UNCERTAIN ENVIRONMENT**

**Piped water supply in a phased approach:
a case study from Mozambique**

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A general assumption in the rural water supply sector is that investments should be made with a long time-frame and sustainability in mind. However, in reality it is difficult to access sufficient water and funds to build systems that can cater for rapidly growing small urban centres for the next 20 years within a short time frame. This paper describes the case of Quissanga in Mozambique, where rapid intervention was necessary due to regular cholera outbreaks, but where the nearest water source could not cater for long-term demand being an island aquifer. Even so, a piped system was put in place and the source's capacity was later expanded through using an innovative technology in the form of a collector well. Using this phased approach, the community will be able to access critically necessary safe drinking water for 5 years while planning and fund-raising for the large project is taking place.

Introduction

Water supply to rural centers is increasingly in focus in Africa. People are drawn to these fast-growing villages or small towns which are also centres for trade and basic services such as government offices, education and health. Populations typically range between 2000 and 15,000 and population growth is often above average. A higher density of economic activity also leads to demands for higher levels of service in terms of water supply, such as private connections for institutions and businesses and public taps for the households. However, such piped schemes require a significant investment in order to provide storage and distribution to a fast-growing demand (Lockwood and Smits 2011). This is especially true in water-scarce areas such as the coastal areas of Northern Mozambique, where the groundwater is prone to salt-water intrusion and the permanent surface water sources are few.

Quissanga

Quissanga is the administrative headquarters of Quissanga District in Cabo Delgado Province in Northern Mozambique. The small centre located on a hill overlooking the ocean is located approximately 120 km north of the provincial capital, Pemba. Quissanga has between 5000 and 8000 inhabitants and in addition to the government administration institutions it also has a hospital, a salt extraction business and a guesthouse. Other than that, the population mainly relies on fishing and small-scale agriculture of maize, rice and vegetables. The water situation of Quissanga is unique. A number of shallow wells are located in the most populous areas near the beach, but they all have quite saline water (> 1500 mg/l) and many dry up completely in the dry season. The only fresh water source, already identified by the Portuguese colonialists, is situated 3.5 km away from the centre on an area that is completely surrounded by sea water during high tides and therefore has the characteristics of an island aquifer. The Portuguese had built a piped system to supply their houses which now host the government institutions and the residences of the government officials. However, the system had not been operative since the 1960s. Nevertheless, a concrete water tower with a capacity of approximately 20 cubic metres and two large-diameter wells and pump/generator houses were still standing.

The water situation for the local population in Quissanga was challenging. People in the most concentrated area near the beach had to walk the 3 km to Mecute (see Fig. 1) to the fresh water source or use water from the salty wells in the densely populated area. Previously, they had been fetching water directly from the Portuguese well but in 2008 another NGO rehabilitated and sealed the well and installed a solar pump that distributed water to two public taps. This briefly improved the quality and safety of the water, but the solar panels were stolen and then the pump broke down, and since the well was sealed and fenced the people now had to rely on two shallow wells in the village of Mecute and otherwise dig holes in the sand until they could access the water table. Many of these holes were dug close to the settlement, and coupled with poor sanitation it is no surprise the population was suffering from regular cholera outbreaks. Every year in the rainy season in January and February, a large number of approximately 150 people would fall sick despite the efforts of the health workers to chlorinate the wells once in a while. The civil servants would use the government tractor and government fuel to drive to Mecute every day and fill water in drums. In addition to causing disease and death, the water situation hampered economic development and efficiency of government services, and made Quissanga unattractive for civil servants, business owners and NGOs alike. In addition, people would spend considerable time and effort walking 6 km every day, mostly done by women and children.

A phased approach

Planning and assessment

Fontes Foundation, a Norwegian NGO, was hired in 2008 by Statoil, a Norwegian oil company to carry out a corporate social responsibility (CSR) project in Quissanga. Statoil has a concession for several blocks offshore just outside Quissanga, and was working on exploration by seismic surveys in 2009 to 2011. When local leaders were consulted where the company could make a contribution, water was highest on the agenda. However, a first assessment in 2008 showed that the aquifer in Mecute, being an island aquifer that is only replenished by the infiltration on its own surface, would not be able to satisfy long-term demand which was estimated to 250 cubic metres per day. Boreholes and shallow wells in the surrounding areas are all salty, and the only permanent surface water source, River Nquiliti, is roughly 20 km away. Statoil did not have the funds to embark in such a large project, however wanted immediately to respond to the request from local government entities and the community. In addition, the cholera season was coming up and health workers and local leaders were dreading a new period of disease and death.

Consequently, Fontes Foundation proposed a phased approach: a water system using the existing Portuguese well would be installed to bring safe water to the most populous area near the beach where roughly 90% of the population lived. This would alleviate the public health situation and at least provide the population with a minimum of safe drinking water per person. Subsequent phases of “permanentization” and expansion would then follow, including a more thorough assessment of a large project using River Nquiliti as a source. This proposal first found some resistance especially in government. There was clearly a fear that the donors and the NGO would abandon the project once the first phase was over. Some government officials thought it would be better to refuse the small project in order to pressurize the donor to finance the huge, long-term project. In addition, preparation and mobilization of the community was necessary especially to explain the need for payment for the water, a notion that is still difficult to get acceptance for in Mozambique.

Rapid implementation

Fontes Foundation has over the years developed a unique implementation approach. Through a mixture of emergency technology and careful planning and design, the entire water system is put in place in only a few days. This makes it possible to keep the community and the local government involved and engaged something that is crucial in order to build ownership and capacity for operation and maintenance. In the case of Quissanga there was also a strong health argument to get safe water to the population fast. Using this approach, the first phase of the project was installed in only 8 days in January 2009. Both community members and government officials admitted they did not believe it when Fontes Foundation announced there would be safe water in town in a matter of days. Despite their doubts, everyone participated with great enthusiasm and more than 6 km of trenches were dug and pipes laid, as well as a pump installed and storage tanks erected. The first phase had two temporary public tap stands with 6 taps each; one in the middle of the most densely populated area near the beach and one closer to the government buildings. Being early in the

rainy season, the system was able to produce about 40 cubic metres a day, not a large quantity for 5 to 8000 people but sufficient to prevent the cholera outbreak and stimulate economic growth. Local individuals were elected and trained for the management of the system, technical maintenance and water sales. The operations were closely followed by an extension worker the first year, and government officials were also trained to assume their role of oversight.

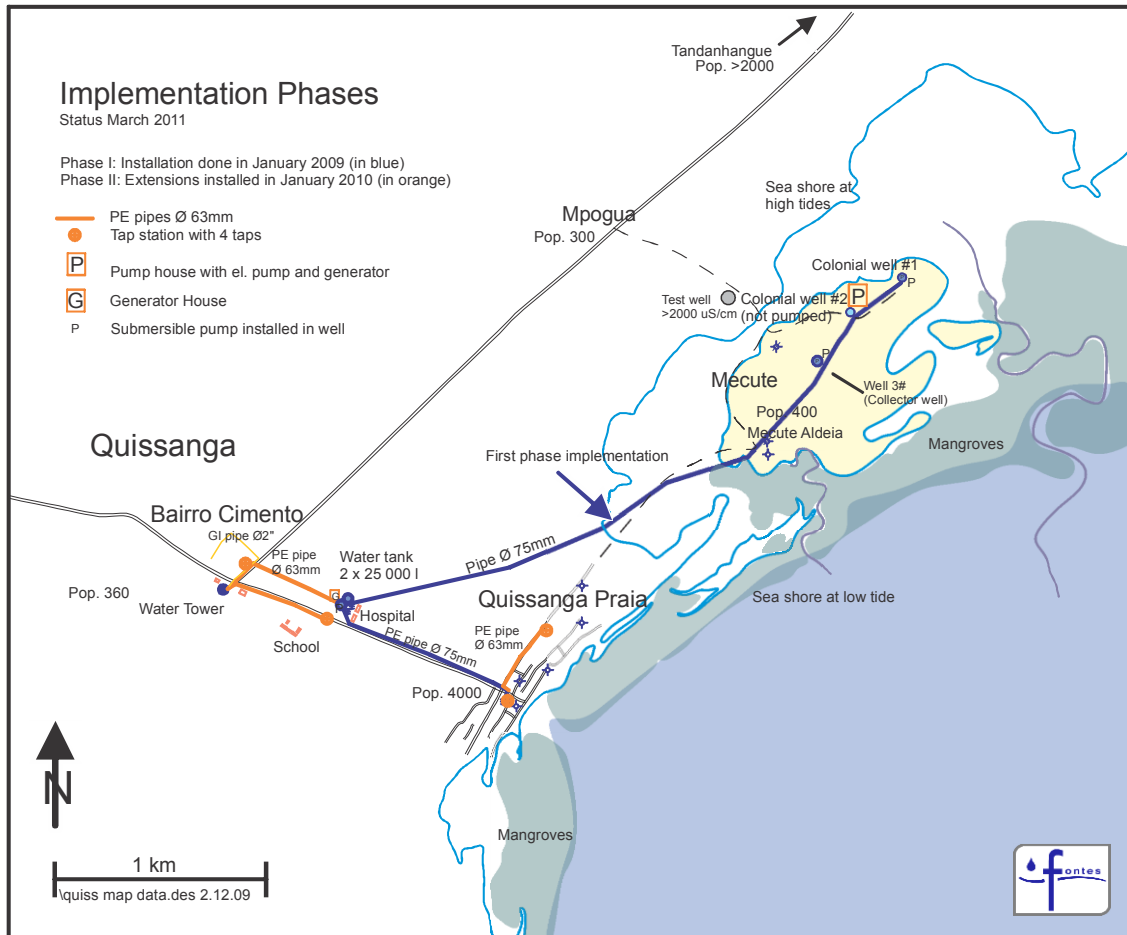


Figure 1. Sketch of the Quissanga area with the high tide line shown leaving the Mecute area as a sandy island with a groundwater accumulated by rain water. Typically the interaction of sea water and seasonal rain let the groundwater become a delicate and limited resource.

“Permanentization” and expansion of network

The second phase included the construction of four permanent public tap stands. In order to reach the administrative buildings that are at a considerably higher altitude, a second pumping cycle was introduced from the storage tanks to the old Portuguese water tower, which was rehabilitated. Safe water could now be accessed in all main areas of the town. An important activity of this phase was also to consolidate the management structure of the system. The Mozambican water policy recommends the contracting out of piped schemes to the private sector, however a study of experiences of nearby systems showed that this had largely been unsuccessful in Northern Mozambique. Despite the population numbers these rural centres are still relatively poor with limited purchasing power. Running costs are high using generators to run the pumps, since there was no connection to the power grid. Low margins therefore make the systems unattractive for outside companies. After some persuasion, the government agreed to let a local community group manage the project. Fontes Foundation trained a manager, vendors and technicians in technical maintenance, operations, management and accounting. The system made enough money to pay them all a small allowance at the end of the month, and to keep some money for future repairs. The management group encountered a number of problems in the beginning, which is normal, so considerable effort was put into the

follow up and training of this group during the first year and a half. In addition, the district government officials were trained in how best they could support the management team, but also where they were not allowed to interfere. The community also needed sensitization especially in the need for payment. Government officials repeatedly intimidated the vendors if they refused to give them water for free or on credit.



Figure 2. Community engagement during construction phase (left) by digging trenches for more than 6 km for the pipelines. Storage tanks of a type also used in emergency response, but with long lasting quality were installed to enable storage capacity of at least 40 cubic meters (right).

After more than two years after installation and extension, and Fontes Foundation has handed over the project to the people of Quissanga, it is encouraging to see that project is functioning well, is accumulating money for the operation and maintenance and receives the governmental support which was very difficult in the beginning to attract.

Increasing the capacity

When the next dry season hit the limited capacity was clearly felt. By now, people had become used to the water and consumption had increased. In addition, several businesses had settled in town, such as a second guest house and a small fish factory. Fontes Foundation provided close follow up in order to find a balance of reducing the risk for over-pumping and saltwater intrusion, but extracting the maximum possible volume to meet the demand. To achieve this, technicians were trained to carefully monitor the salinity in the well, and to follow strict pumping schedules that would leave the aquifer to rest in between. Planning started of how best to increase the capacity. After careful design and calculations, an innovative technology was adopted. In aquifers that are surrounded by salty water, it is necessary to gain access to the top layer of fresh water in an efficient way. After a geological study, the spot on Mecute Island was selected where the freshwater lens would be the thickest. Here, a large diameter well was constructed in a suitable distance from an existing pump house where the generator was located. Using perforated pipes, the collection diameter of the well was greatly increased by flushing and pushing the pipes horizontally into the sand up to 6 metres from the well walls (Fig. 3). This increased the collection diameter and reduced the drawdown during pumping. The pipes were inserted at three levels, so as to always access the top layer of the aquifer. The well was a great success, and the water quality was considerably better than from the Old Portuguese well. With this intervention, it was possible to more than double the capacity of the system.



Figure 3. As part of the “permanentization” proper pump houses were built (left). To increase extraction of water while carefully using the top layer of the limited fresh groundwater, horizontal filter pipes were flushed into the sandy soil up to 6 meters out from the central large diameter well (right).

River Nquiliti project

After using the system successfully for three years, the government finally managed to raise the funds for the large-scale project pumping water all the way from River Nquiliti over a distance of roughly 20 km. This complex project will abstract and treat water from the river and distribute it to a number of other centres and villages along the way. Planning and design took place in 2012 and some materials are already on site, but it is likely to take at least until 2014 for the system to be operational. When it reaches Quissanga, the water will be led into the existing distribution network set up under the Fontes Foundation project, with the public taps but also with the possibility for house connections that was already put in place.

Benefits of the phased approach

The Quissanga case study shows that it is not necessary to wait until funds are available for a big system, but that water systems can also be successfully implemented in a phased approach. In the case of Quissanga, the approach had a number of benefits:

- Safe water was made rapidly available and prevented further cholera outbreaks in Quissanga. Even if the quantity was limited, people were able to access sufficient safe water for drinking and cooking.
- The community was slowly introduced to the notion of paying for water, which is now an established practice in Quissanga. This will make it much easier for the large system to break even and attract a private operator.
- Local capacity has been built in technical operations and maintenance, management, accounting and water sales. A number of different people have passed through the management committee and the trainings, and gained experiences that can help them in their daily lives. It is also possible that some of the people involved in the management committee might be employed by a future private operator.
- Important capacity has been built at district government level, especially in the department of public works. The department is now aware of technical maintenance, as well as the basics of utility management and financial management supervision. Despite high turn-over at district level, it is likely that this capacity will benefit the future management by the district of the contract of a private operator, and that it will be more capable of ensuring sustainable water services for the population.
- The approach of working in phases and involving the government and the population at every step has created ownership of the project. The project has still been supplying water on a continuous basis even after the NGO left in 2011. The ownership feeling was particularly manifested when the district local government paid for the power line and the connection of the pumps to the national grid once it arrived in Quissanga in 2012.
- The costs and time of construction of the large project will be reduced by the fact that the supply pipe can easily be connected to the existing distribution network.
- The system using water from Mecute will be a back-up system in case the water from the Nquiliti source is not available due to different reasons.

- By providing water to the population for at least five years before the Nquiliti system is operational, the project has achieved 40,000 Water-Person-Years (WPY) (Koestler et al 2010), a measure to indicate how many persons have received safe water services for one year, compared to a scenario where the phased approach would have been abandoned in favour of waiting for the large project. This would also allow to estimate the cost of safe water per person per year to be in the range of 50 USD/person/year for this project.
- In addition, using a phased approach makes it easier to adapt to changes in an uncertain environment over time. In coastal areas, aquifers can change quickly due to the effects of climate change. In addition, population dynamics, settlement patterns and economic development can lead to changes in demand and location of populations that the system needs to cope with. For example, by the time the extension was made to the upper areas of the administrative block, a whole new settlement had emerged between the two original settlements. The phased approach made it possible to cater for this area and extend a distribution line to them which will allow for future private connections.

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