

Adaptable water infrastructure in Oman: Moving to desalination in Ash-Sharqiyah



Islamic Development Bank Group

The Ash-Sharqiyah Sands Water Supply Scheme, as it is known in Oman, was prompted by repeated droughts and acute shortages of water.

People were using only an estimated maximum of 75 litres of water a day per head on average for drinking, cooking and washing – half, at most, of the amount

residents in developed countries might use, and about a third of the volume the Government of Oman wanted to provide.

An aflaj network for the 21st century

Both the qualitative and quantitative pictures for water in the area were poor.

Really,
it was a great
success





Ali Juma Ali Al-Satmi's modern home was connected to mains water as part of the project, making the task of looking after their five children hugely easier for him and his wife. He and his PAEW colleagues look back on Oman's water heritage at the Al-Kamil Wa Al-Wafi Old Castle Museum (pictured), which features ancient wells, earthenware pots and *kerba* – water bags made of animal skin.

Diarrhoeal disease was a real danger; the rate of waterborne illness was high. Water from private wells was often brackish and polluted, while the government had been drilling individual wells from which potable water was trucked to separate communities.

Another source was the ancient *aflaj* network, which is principally for irrigation. The Arabic word is the plural of *falaj*, meaning 'channel', and describes a system of irrigation in which water is carried to villages from natural sources like valleys, ponds and springs. One Ash-Sharqiyah *aflaj* is a UNESCO World Heritage Site. The importance of protecting the *aflaj* system was recognized early on in the scheme's planning stages.

"Water was fetched and carried by traditional means," says Othman Salim Al-Dhahli, Southern Ash-Sharqiyah Operations Manager for Oman's Public Authority for

Electricity and Water (PAEW), which manages the infrastructure today. "Everybody got water by themselves. It was a lot of work." People were often obliged to carry water long distances in traditional *kerba* animal-skin sacks on donkeys and camels.

What was needed, in effect, was an *aflaj* network for the 21st century that would be able to draw on natural groundwater and other sources like desalinated seawater.

When geologists working for the Government of Oman discovered two major underground aquifers containing some 24 billion cubic metres of potable groundwater, it was calculated that about half could be brought to the surface and distributed economically.

A new project – intended to be an exercise in distribution as much as extraction – was born. It was designed to supply potable

water, meeting official Omani standards, to major Ash-Sharqiyah towns and villages like Al-Kamil, Al-Wafi, Jalaan Bani Bu Ali and Jalaan Bani Bu Hassan, Al-Ashkharah and Falaj Al-Mashaikh. Other more remote settlements were to be supplied by tankers using newly constructed filling stations. The Islamic Development Bank (IsDB) agreed to provide just under US\$20 million – some 20 per cent of the total cost.

Basic design started in 1999 and work on the main water supply system began in 2001; the first taps were turned on for the new water in May 2004, connecting some 80,000 people to mains water for the first time. The last extension to the project was finished in 2007.

The main element of the project was the drilling and development of production and monitoring wells, and included more than 400 kilometres of high-density polythene distribution pipes. The components supported by IsDB *istisna'a* finance¹ were



The way it was: Khalfan Al-Hashmi holds a traditional water-carrying *kerba* made from animal skin at the heritage museum he founded in Al-Kamil, in Southern Ash-Sharqiyah governorate.

Engineer Amir Khatar Al-Mamari makes adjustments at the Al-Kamil pumping station. Some 35,000 homes had been connected to mains water through the new infrastructure by 2014.



the supply and distribution systems for Al-Kamil and Al-Wafi, and all the electrical, mechanical and fire-fighting equipment for one of two project extensions that took the network into a number of coastal towns.

As well as the government itself, other donors – each contributing about a third of the total – were the Kuwait Fund and the Arab Fund. The original implementing agency in Oman was the Ministry of Regional Municipalities, Water Resources and Environment.

Overall, the main components of the completed infrastructure – whose administrative centre is 160 km south of Muscat, near Al-Wafi – were as follows:

- 50 new wells (production and monitoring) in two desert fields
- Nearly 700 kilometres of pipeline of all kinds
- Four reservoirs
- Three pumping and treatment stations
- 35 tanker-filling stations, tanks and generators.

Strong competition in bidding and the prevalence of local contractors

A pumping station at Al-Kamil, part of the IsDB-funded infrastructure now celebrating its tenth anniversary of the start of operations. This and other stations now send 76 million litres of water into a huge network every day.





The IsDB-supported water network in Ash-Sharqiyah is now supplied from a desalination plant in Sur, world famous for its dhow-building yards.

The move to desalination

The network now serves at least 35,000 households, or some 210,000 people using the standard Omani headcount per home of six. Exact individual consumption is difficult to calculate, but it is put at between 200 and 250 litres per person per day – above the original government target. Othman Salim says his stations pump 76 million litres a day into people's homes for all uses – more than enough to give everyone in the catchment area a good supply.

More than half the wells dug were new production or 'mother wells'; the rest were smaller 'monitoring wells' – a project add-on that injected a strong sustainability

component by reading the level of the water table in case too much groundwater was extracted. "If you pump too much, the *aflaj* could be adversely affected," says Dr Said Khamis Al-Khamisi, Muscat-based Projects Manager for the PAEW.

"This was one of the most important groundwater supply projects ever," he adds. "Really, it was a great success."

The network is now supplied from a new desalination plant in the regional capital Sur – a Gulf port long-famous for its dhow-building yards. Desalination, with groundwater as a strategic reserve, has been the Omani Government's long-term strategy for some time.

"We knew the groundwater in Ash-Sharqiyah would not last forever," explains Dr Al-Khamisi. "So we designed the network in such a way that it doesn't matter what the source is." In this sense, the new infrastructure has proved highly adaptable. It includes ground-based reservoirs, water towers and tanker-filling points, providing well over 20,000 cubic metres of storage.

A computerized System for Control and Data Acquisition (SCADA) was also installed. This contributed to proper monitoring, facilitated maintenance and reduced the response time needed for technical problems to be fixed and leaks plugged.

Extending the reach, not the bill

The final bill for the project came in at about ten per cent under budget, despite it having

been extended to cover additional villages. This saving was attributed mainly to strong competition in bidding for the main contract and the prevalence of local contractors.

In the original appraisal, for example, transmission pipelines represented 25 per cent of the total budget, but were only 18 per cent of the actual cost, without any reduction in scope.

The overall reach of the new network was extended by just over 40 per cent when nearly 550 kilometres of delivery pipeline was installed instead of a planned 390 kilometres (see also Scalability, opposite). The 19 monitoring wells were not envisaged at start-up, and the number of elevated water tanks (as shown in the cover photo) was increased to 15 from the planned number of 10. Other project components were reduced in size, but the net effect was a major expansion of the project's reach.



Ash-Sharqiyah water infrastructure by numbers...

US\$19.2 million Original IsDB contribution under *istisna'a* financing

20% Proportion of total cost met by IsDB

31 New production wells dug in the sands in all phases

700 Kilometres of new pipeline of all kinds laid

76 million Total litres of water pumped per day by 2014

35,000 Ash-Sharqiyah homes connected to new infrastructure by 2014

210,000 Population served, based on average Omani family size of six

10 Towns connected to the water network

Success factors

Sustainability

"Before you do a project, count the butterflies," say local engineers concerned with maintaining biodiversity. In order to minimize the impact on the traditional *afraj* network and local fauna and flora, the Ash-Sharqiyah water project included a special environmental impact study. In addition to the monitoring wells, a system of pre-paid credit cards for consumers was set up that made it easier to control supply and minimize leakage. New water towers and other infrastructure were designed to be compatible with both the natural environment and Oman's rich architectural heritage.

Specialized contractors

The 'pre-qualification' of contractors, familiar in the construction industry – i.e. thorough examination of qualifications at the recruitment stage – played an important role in the success of this project. Post-completion operations and maintenance were subcontracted to a specialized company, as was billing and revenue collection.

Scalability

The original project plan foresaw 26 production wells, but this was quickly increased to 31. The network was expanded in two separate phases to coastal regions, when the needs there became evident, and to an additional inland town, El-Jawabi. These extensions together accounted for nearly 150 kilometres of new pipeline. The complete network ended up with nearly 550 kilometres instead of the planned 390.

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¹ A sale where an asset is transacted before it comes into existence. A purchaser orders a manufacturer to manufacture a specific asset according to the purchaser's specifications at a pre-agreed price, which is payable either in a lump sum or instalments at any time, as agreed.



Contact:

Manager, Operations Policy and Compliance Division
Operations Policy and Services Department
Islamic Development Bank Group
PO Box 5925, Jeddah 21432, SAUDI ARABIA

Email: idbarchives@isdb.org | Tel: +966 12 6361400 | www.isdb.org