



Case Study - Jordan

How Madaba's Water and Wastewater Utility is finding innovative Solutions to operational Burdens while reducing Carbon Emissions

Activity

Using the WaCCliM approach to solve operational burdens and reduce carbon emissions

Region

Middle East

Sectors

Water and wastewater

Challenges

Droughts, meeting water demands and low wastewater coverage

Good Practice

Energy efficiency measures

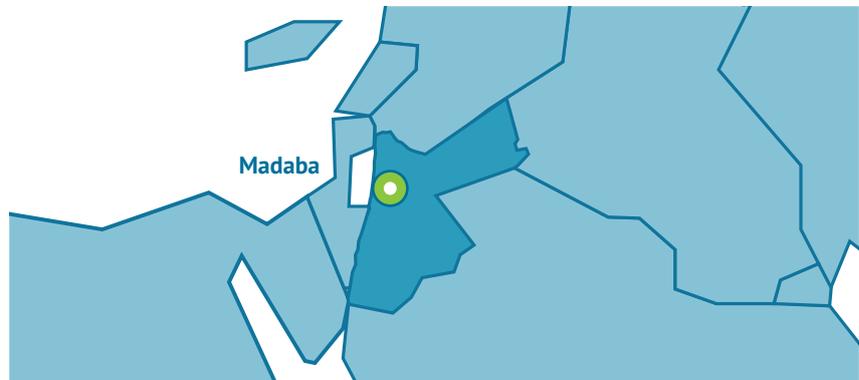
Timeframe

2016–2019

Case Summary

In Madaba, the Miyahuna Water Company conducted a study to determine and address greenhouse gas (GHG) emissions from its operations. Miyahuna operates both water and wastewater systems in the city. The GHG assessment was conducted using the Energy Performance and Carbon Emissions Assessment and Monitoring (ECAM) Tool. This highlighted that 90% of energy consumption is linked to the extraction of drinking water.

In order to decrease the utility's carbon footprint, several GHG reduction measures were evaluated. However, some are difficult to implement due to financial constraints. The most feasible option was the improvement of the pumping system. This would reduce annual electricity consumption by 35–50%.



St. George's Church: Fragment of the oldest mosaic map of the Holy Land, showing the Jordan River and the Dead Sea. ©Adobe Stock

Background

Madaba is located 54 km east of Jerusalem and 35 km southwest of Jordan's capital, Amman, close to the Dead Sea. It has an area of about 1,000 km² and a population of approximately 190,000. Madaba Governorate is divided into two directorates: Madaba directorate, which is 498.3 km², and Deeban directorate, which is 543.6 km².

Madaba is a quiet residential city, rich in historical treasures. It is best known for its well-preserved Byzantine and Umayyad mosaics, and has been nicknamed the "city of mosaics". These wonderful historical artefacts have lasted for centuries because of the dry desert environment in Jordan. However, the arid climatic conditions are also the reason Jordan is facing severe water shortages.

Miyahuna is the sole provider of water and wastewater services in Madaba. It serves customers in moderate elevation areas (750–800 m). Most people are connected to the drinking water supply (99%), but only half of them are connected to sewer networks (49%). The other half depend on septic tanks and cesspools.

Challenges

Droughts and scarcity:

Jordan is facing an unprecedented level of sustained drought. The current per capita water supply in the country is about 100 m³/year. The existing systems already exceed their capacity under normal conditions. Furthermore, the current influx of Syrian refugees is putting extra strain on the system. Per capita water availability is predicted to decline to 91 m³ by 2025. Thus, Jordan must act to secure its water future.

Drinking water distribution:

Currently, Miyahuna operates all water and wastewater systems in Madaba, Amman and Zarqa. The logistics of serving its 780,000 customers are complicated. Most only receive water two days a week by government mandate. In the 1980s, the Government of Jordan initiated a programme to regulate hours of service to various neighbourhoods to achieve sustainable water distribution. However, there are still challenges to meeting the demand.

High energy costs:

The energy costs represent the highest part of the total costs of the water sector. The ECAM assessment in Madaba's urban water cycle showed that about 60% of the total costs derive from energy usage. In addition, the end-user technologies are highly inefficient and thus costly to operate.

Sewage sludge management:

Handling sewage sludge in Jordan is an environmental and health challenge. Many Jordanian municipalities lack of proper sludge management and infrastructure. Sludge is unutilised and improperly stored and disposed of. The study by Miyahuna-Madaba showed that current disposal methods produce high emissions.

Activities

Baseline assessment:

The Miyahuna Water Company used the ECAM Tool to conduct a baseline assessment of Madaba. The aim was to identify indirect and direct sources of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) throughout the urban water cycle.

The results showed that, on average, the entire urban water cycle of the city of Madaba generates 28,000 tons CO₂-eq per year. Most of the utility's electric energy consumption, 71%, comes from the drinking water abstraction stage. In Jordan, most of the water lies deep beneath the surface. The process of drawing water from its source (the Waleh and Heidan wells) requires large amounts of energy. Distribution to the end-user further increases this cost.



Jordan is one of the world's most water-scarce countries. About 75% of the country can be described as having a desert climate with less than 200 mm of rain annually. ©Adobe Stock

Solutions:

The baseline assessment revealed many options for improving the utility's daily operations and lowering the carbon footprint. Those options range from simple switches, such as controlling the pumping rate, to pragmatic solutions, such as incorporating solar energy resources or digesting sludge for biogas valorisation. Several measures were identified, but only those with the highest impact on GHG reduction were investigated more thoroughly.

The most promising measures were compared in a final options study. They included measures to improve the service, reduce energy consumption and implement sludge management. The highest priority options included pressure management, network maintenance, pump retrofitting, harnessing solar energy using photovoltaics (PV) and integrating sludge digestion.

Institutions Involved

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the International Water Association (IWA) developed the WaCCliM Roadmap. This is an approach to optimising the operation and services of utilities, while lowering their GHG emissions. The aim is to strengthen the water sector's contribution to mitigating climate change.

The Ministry of Water and Irrigation (MWI), the Water Authority of Jordan and, particularly, the Performance Management Unit played a significant role in supporting the work of WaCCliM. They liaised with Miyahuna, following up on all phases of WaCCliM through constant monitoring and support.

Using the WaCCliM approach, Miyahuna conducted studies to determine their overall operation's baseline GHG emissions throughout the urban water cycle of Madaba.

Financing

With the support of USAID (US Agency for International Development), Miyahuna was able to maintain networks in Madaba. The WaCCliM project is part of the International Climate Initiative (IKI), supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). It contributed financially to the procurement of efficient variable frequency drive (VFD)-driven pumps.

High investments are required to finance the other mitigation options identified, such as PV panels and sludge digesters. A total investment of 5.32 million EUR will be required to complete the Madaba mitigation plan. One option to cover these costs is to seek Green Finance.

Impacts

Impacts of present implementations

With the implementation of new VFD-driven energy-efficient pumps, the energy consumption of the water abstraction process is reduced, **saving approximately 1,400 MWh** per year and **avoiding emissions of 1,000 tons of CO₂-eq** per year.

The measures, including network maintenance and managing pressure, will significantly reduce water losses, electricity consumption and costs, and thus alleviate emissions.

Impacts of possible future measures

Over 6,000 tons of CO₂-eq per year could be avoided with biogas valorisation. However, this requires a higher initial investment than some other measures, such as investments in well pumps.

Another measure with potentially high energy-saving benefits is the use of solar energy in wastewater treatment. In arid countries, the sun has high potential as an energy source.

These measures hold much promise for a country like Jordan. However, their compatibility with the utility's present priorities should be considered.

Success Factors

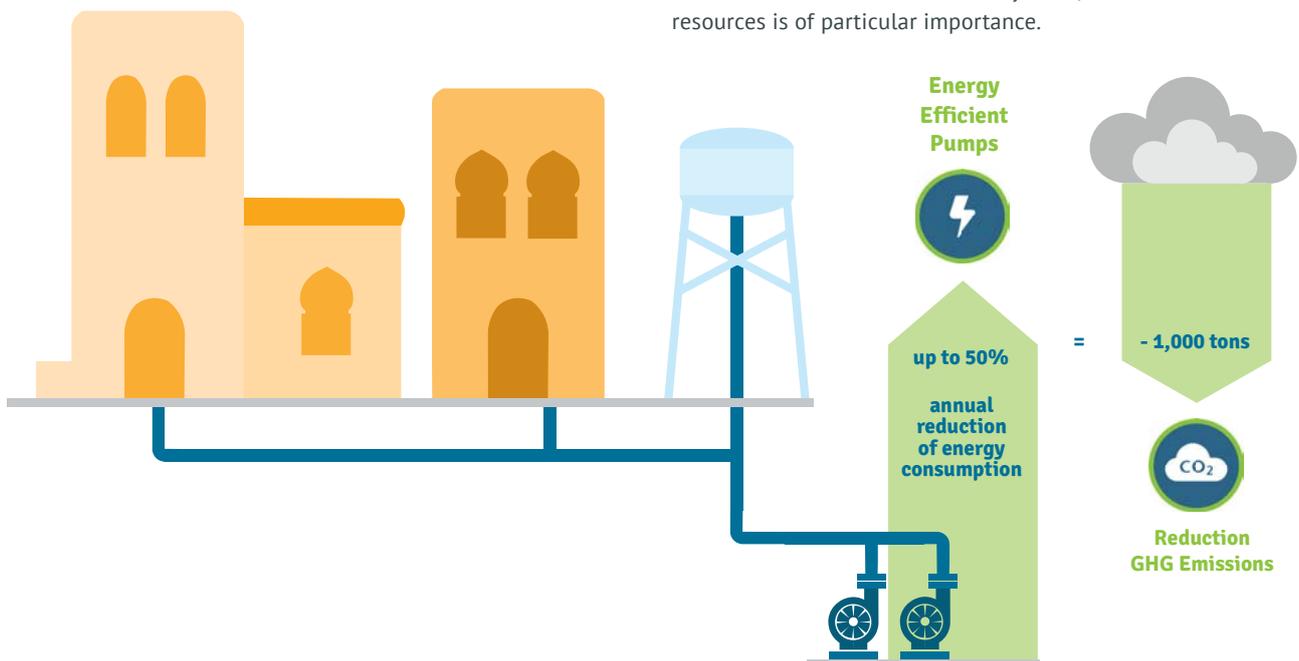
The WaCCliM assessment successfully identified sources of GHG and energy efficiency issues. These results were used to devise practical mitigation measures.

The MWI drafted a new high-level action plan for energy efficiency and GHG reduction in accordance with the water sector's commitment to Jordan's nationally determined contributions (NDCs). Out of this draft and since the Miyahuna Water Company is responsible for water and wastewater services in several areas of Jordan, it has created its own energy efficiency and GHG reduction policy. This policy builds on Miyahuna's role to support the goals of the MWI action plan. Furthermore, the policy aims to reduce GHG emissions from Miyahuna's water facilities. The policy targets were inspired by WaCCliM's goals and the study by Miyahuna.

The creation of this policy supported the implementation of the measures. It also encouraged a commitment to the sustainable alleviation of energy deficiencies and GHG emissions reductions in Miyahuna Water Company.

Obstacles Overcome

High investments are needed in order to implement the GHG reduction measures efficiently. Thus, access to financial resources is of particular importance.





Mohammad Awamleh, CEO Deputy Miyahuna (left) and Bassam Al Hayek, JOR Project Leader (right) examining insufficient pumps which cause high energy losses and lead to an increased amount of CO₂ emissions. ©GIZ

Lessons Learnt

WaCCliM provided **innovative tools for assessment and monitoring** of the water sector.

Introducing climate change mitigation at a utility level

increased the overall awareness of climate change and its cross-linked relation with the water sector. It emphasised the sector's role and responsibility in coping with it. The adoption of sustainability roadmaps and implementation of mitigation measures led to additional benefits. These included performance improvements, cost reductions and an enhanced access to green funds and other financing mechanisms.

Both the study by Miyahuna and the ECAM assessment showed that **system deficiencies due to low pump efficiency and high non-revenue water** are the major causes of high costs and increased emissions. By continuously monitoring emissions, the reasons for the deficiencies could be identified and tackled. Furthermore, the high potential of renewable energies, such as PV technologies, to reduce energy costs was highlighted. Additionally, anaerobic digestion during the sludge treatment produces biogas, which might be used for energy generation.

Replication

The WaCCliM Roadmap was adopted to achieve sustainability and reduce emissions in different wastewater treatment plants (WWTP) in Jordan. For instance, Mu'ta-Mazar and Wadi-Mousa WWTPs (southern Jordan; managed by Aqaba Water Company) as well as Ramtha WWTP and Kufranja WWTP (northern Jordan; managed by Yarmouk Water Company) used ECAM to determine their baseline and analyse the sources of the emissions to devise mitigation options. Staff were familiarized with the effects of climate change on the water sector and were trained to use the ECAM Tool to assess, monitor and continuously seek mitigation opportunities.

Replication should be encouraged with incentives. Furthermore, the range of benefits, such as cost reductions performance enhancement or environmental stewardship, should be emphasised. This will make replication more attractive.

Finally, a cooperative environment through political support is needed to successfully continue and replicate the WaCCliM approach.

Best Practice

The WaCCliM project has provided a framework for Miyahuna to pursue sustainability and continuous development. It provides guidance in reducing GHG emissions and electricity consumption, while keeping service levels at optimum.

This was achieved in the example of Madaba by analysing the status, devising solutions and implementing reduction measures within a clear green policy.

Next Steps

Enhancing the energy efficiency and cutting the GHG emissions of the water utility is a continuous process that demands frequent monitoring. The pumping stations, for instance, become less efficient over time. Therefore, it is crucial for the utilities to continuously collect and analyse energy data to ensure they are operating efficiently.

In the long term, measures such as biogas valorisation and the use of solar panels, could be implemented, providing a renewable energy source. The implementation would further decrease the indirect emissions of GHG and would help to achieve an energy independence of the wastewater treatment plant. However, this will mainly depend on the available funds and the support of external financing sources.



Participant of an Energy Performance and Carbon Emissions Assessment and Monitoring (ECAM) Tool training. ©GIZ

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