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Ministry of Water & Irrigation



Resilience & Innovation in Jordan's Wastewater Sector






Contributions of German-Jordanian development cooperation





→ Jordan's agriculture sector requires a large amount of water (top); Mujib dam (middle); operators taking wastewater samples (bottom)

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Foreword

**HONORABLE ENG. MOHAMMAD NAJJAR
MINISTER OF WATER AND IRRIGATION,
GOVERNMENT OF JORDAN**

Water is the basis for our future. It is the key to health, prosperity and growth, and central to the achievement of Jordan's economic and development goals. It is also one of our greatest challenges. As a result of climate change, population growth, the over-abstraction of groundwater and reliance on transboundary water sources, Jordan faces acute water scarcity.

The Ministry of Water and Irrigation is responsible for effectively and efficiently managing water resources so that Jordan is able to meet its present water demand – and tomorrow's as well. Solving the water scarcity challenge requires that we better manage our current water resources and, at the same time, work to increase available water supplies. Expanding the use of non-conventional water resources, including treated wastewater, is a key strategy in this respect.

Jordan can point to many achievements already. Every year more than 170 million cubic meters of treated wastewater are used for restricted irrigation. This represents more than 90 percent of the effluent generated by wastewater treatment plants across the country. Our vision is to expand the use of treated wastewater for a wider range of applications in agriculture and industries in the future. To achieve this ambitious aim, our treated wastewater must consistently meet a very high standard. We continuously update our reuse standards to support this development.

The National Water Strategy 2023–2040, which outlines our vision and pathway to a water secure future, envisions an even greater role for non-conventional water. It also guides our approach for the increasing amount of water which will be supplied through the national conveyor. Managing these future water sources and achieving higher non-conventional water targets will require us to continue expanding the coverage of wastewater collection and treatment systems – and to ensure that they are resilient in the face of new challenges, not least intensifying climate change.

German development cooperation has been an important and reliable partner to water sector institutions in Jordan for many years. During this time, we have made significant progress in improving wastewater systems and making them more effective, energy efficient and climate-friendly. The institutions which oversee and deliver water and wastewater services have become stronger as well. We remain committed to continuously improve and optimise the sustainable management of our wastewater and are pleased to be able to share some of the highlights from the German-Jordanian partnership in this publication.

Water and energy are two of the key drivers for achieving the strategic goals outlined in Jordan's Economic Modernisation Vision. The two pillars of this vision – accelerated growth and improved quality of life – can only be achieved through cross-sectoral partnerships between multiple ministries and public institutions. The Ministry of Water and Irrigation embraces the chance to sustain the fruitful collaboration with Germany, aiming to enhance the utilisation and long-term viability of Jordan's natural resources on its journey to realising the Kingdom's vision.

WASTEWATER MANAGEMENT IS CONNECTED TO MANY GLOBAL CHALLENGES – AND KEY TO ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS (SDGs). SAFE MANAGEMENT, TREATMENT AND REUSE OF WASTEWATER...



Contributes to social and economic development, particularly in poor and urban areas.



Enhances food security by increasing the volume of reclaimed water available for agriculture.



Limits the number of people exposed to water-related diseases, and reduces malnutrition and preventable deaths among children.



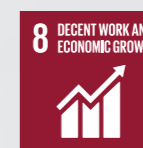
Enhances children's attendance and performance in school.



Contributes directly to ensuring the availability and sustainable management of water and sanitation for all.



Can increase the share of renewable energy and contribute to improvements in energy efficiency.



Enhances opportunities for resource recovery, thereby contributing to decent work and economic growth.



Holds enormous potential for innovation, increased efficiency, and the adoption of clean and environmentally sound technologies and industrial processes.



Makes life in urban areas cleaner and more sustainable, and can reduce disaster-related disruptions to basic services when wastewater infrastructure is climate-resilient.



Limits harmful greenhouse gas emissions.



Ensures the conservation and sustainable use of terrestrial and inland freshwater ecosystems.



◀ A farmer irrigating crops with reclaimed water in the Jordan Valley



➤ Wadi Shallalah wastewater treatment plant (top);
Wadi Hassan wastewater treatment plant (bottom)

Summary

Over the past 30 years the Kingdom of Jordan has emerged as a world leader in the use of treated wastewater.

In response to acute water scarcity, the country's water authorities have embraced the use of non-conventional water resources, including treated wastewater, as a core strategy for conserving precious freshwater supplies for a rapidly growing population. This approach has contributed to Jordan's remarkable resilience in the face of mounting pressures on its available water resources, including the arrival of over one million Syrian refugees over the past decade.

As a result of visionary thinking and long-term investments, Jordan's well-developed network of wastewater treatment plants produces 187 million cubic meters of treated wastewater annually. Some 170 million cubic meters of this are reused, representing roughly 15 per cent of all the water used in the country each year.

This 'reclaimed water' is primarily used for restricted irrigation in the Jordan Valley, freeing up large volumes of freshwater to be directed to domestic users in urban areas. At the same time, it helps to secure farmers' livelihoods and the country's food supply.

Jordan's achievements reflect a conscious strategy by the Ministry of Water and Irrigation (MWI) and the Water Authority of Jordan (WAJ) to maximise the potentials of wastewater as a resource.

With support from partners, including Germany, they have worked to remake the technologies, systems and service delivery models which underpin the wastewater sector to steadily increase volumes of treated wastewater. This has included increasing the coverage of sewer networks, expanding and upgrading wastewater treatment plants to generate more effluent, and constructing pipelines to transport treated wastewater.

Long open to innovation, Jordan's water authorities are seizing upon opportunities to make wastewater systems more environmentally friendly – and to optimise operations and reduce costs.

The introduction of energy efficiency measures and greater use of renewable energy – including electricity generated from wastewater and sludge itself – are not only reducing the wastewater sector's climate footprint but are financially beneficial as well. Solutions for the safe and environmentally sound management and use or disposal of sludge are also being introduced.

Jordan's wastewater sector has proven resilient in the face of shocks and challenges, from influxes of refugees to the COVID-19 pandemic. This resilience will be further tested in the years to come as the effects of climate change intensify.

As Jordan works to sustain and build on its achievements thus far, it will need to address the sustainable financing of wastewater services, ensure the conditions for consistent, high-quality wastewater operations, and see through important institutional reforms. Tackling these challenges will be essential for achieving the ambitious targets for non-conventional water set out in the National Water Strategy 2023–2040 – and for ensuring water security, especially for vulnerable people, in the future.

Germany, which has been accompanying Jordan's water journey since the late 1950s, remains a committed partner.

With financial and technical cooperation commitments currently totaling more than 1 billion Euros, the German Federal Ministry for Economic Cooperation and Development (BMZ) is a major partner to the Jordanian water sector. In the area of wastewater, German development cooperation supports its partners to sustain their achievements and to further strengthen the resilience of the country's wastewater systems for new challenges ahead.

ملخص

وكونها منفتحة ومنذ فترة طويلة على الابتكار والابداع، فإن سلطات المياه الأردنية تستغل جميع الفرص لجعل أنظمة الصرف الصحي أكثر ملائمة للبيئة - وهي كذلك تعمل على تحسين العمليات وتقليل التكاليف.

إن إدخال تدابير كفاءة الطاقة وزيادة استخدام الطاقة المتجددة - بما في ذلك الكهرباء المولدة من مياه الصرف الصحي والحمة نفسها - لا تقلل فقط من البصمة المناخية لقطاع مياه الصرف الصحي، ولكنها مفيدة من الناحية المالية أيضًا. وكما يتم تقديم حلول كذلك لإدارة واستخدام الحمة بطريقة آمنة وسليمة بيئيًا.

لقد أثبت قطاع مياه الصرف الصحي في الأردن قدرته على الصمود في مواجهة الصدمات والتحديات، وذلك يمتد من فترة تدفقات اللاجئين للبلاد إلى جائحة كورونا وكما سيتم اختبار هذه المرونة بشكل أكبر في السنوات القادمة مع اشتداد آثار تغير المناخ.

وبينما يعمل الأردن على الحفاظ على إنجازاته والبناء عليها وتطويرها حتى الآن، فإنه سيحتاج أيضا إلى معالجة التمويل المستدام لخدمات الصرف الصحي، وضمان الظروف للقيام بعمليات متسقة وعالية الجودة لمياه الصرف الصحي، وكذلك القيام بالعديد من الإصلاحات المؤسسية الهامة. وستكون معالجة هذه التحديات ضرورية ومهمة لتحقيق الأهداف الطموحة للمياه غير التقليدية المنصوص عليها في الاستراتيجية الوطنية للمياه 2023-2040 - ولضمان الأمن المائي، خاصة للأشخاص المهددون من ناحية مائية في المستقبل.

لا تزال ألمانيا، التي ترافق رحلة الأردن في استخدام المياه منذ أواخر الخمسينيات شريكًا ملتزمًا.

وذلك من خلال التزامات التعاون المالي والتقني التي بلغ مجموعها حاليا مليار يورو ، كما تعد الوزارة الاتحادية للتعاون الاقتصادي والتنمية (BMZ) شريك أساسي في قطاع المياه الأردني. في قطاع الصرف الصحي يدعم التعاون الدولي الألماني شركائه للحفاظ على إنجازاتهم ومواصلة تعزيز مرونة أنظمة الصرف الصحي في البلاد لمواجهة التحديات الجديدة المقبلة.

برزت المملكة الأردنية خلال الثلاثين عامًا الماضية كدولة رائدة عالميا في استخدام مياه الصرف الصحي المعالجة.

واستجابة لندرة المياه الشديدة، فقد تبنت سلطات المياه في الاردن استخدام موارد المياه غير التقليدية، بما في ذلك مياه الصرف الصحي المعالجة، وذلك كاستراتيجية أساسية منها للحفاظ على إمدادات المياه العذبة الثمينة والمطلوبة لسكان عددهم يتزايد بسرعة. وقد ساهم هذا النهج في صمود الأردن بشكل قوي وملحوظ في مواجهة الضغوط المتزايدة على موارده المائية المتاحة، لا سيما بعد وصول أكثر من مليون لاجئ سوري لأرضه على مدى العقد الماضي.

ونتيجة للتفكير الابتكاري والاستثمارات طويلة الأجل، تنتج شبكة محطات معالجة مياه الصرف الصحي المتطورة في الأردن 187 مليون متر مكعب من مياه الصرف الصحي المعالجة سنويًا. ويتم إعادة استخدام حوالي 170 مليون متر مكعب من هذه المياه، وهو ما يمثل حوالي 15 في المئة من إجمالي المياه المستخدمة في البلاد كل عام.

تستخدم هذه المياه المستصلحة بشكل أساسي الزراعة المقيدة في وادي الأردن، مما يوفر كميات كبيرة من المياه العذبة والتي يتم توجيهها إلى السكان المحليين في المناطق الحضرية. كما انها في الوقت نفسه، تساعد في تأمين سبل عيش المزارعين والإمدادات الغذائية للبلاد.

وتعكس إنجازات الأردن في هذه الناحية استراتيجية واعية من قبل وزارة المياه والري وسلطة المياه الأردنية وهذه الإستراتيجية تشيد وتعزز قدرة وإمكانات مياه الصرف الصحي كمورد وداعم لقطاع المياه في البلاد.

وبدعم من الشركاء، بما في ذلك ألمانيا، فقد عملوا على إعادة صياغة التقنيات والأنظمة ونماذج تقديم الخدمات التي تدعم قطاع مياه الصرف الصحي لزيادة كميات المياه العادمة المعالجة بشكل مطرد ومتزايد. وشمل ذلك زيادة تغطية شبكات الصرف الصحي، وتوسيع وتحديث محطات معالجة مياه الصرف الصحي لتوليد المزيد من المياه وإنشاء خطوط وأنابيب لنقل مياه الصرف الصحي المعالجة.



☞ An operator checks the quality of effluent (top); agriculture in the Jordan Valley (bottom)

01

Every drop counts:
Making the most
of a precious asset



Jordan, a water-scarce land

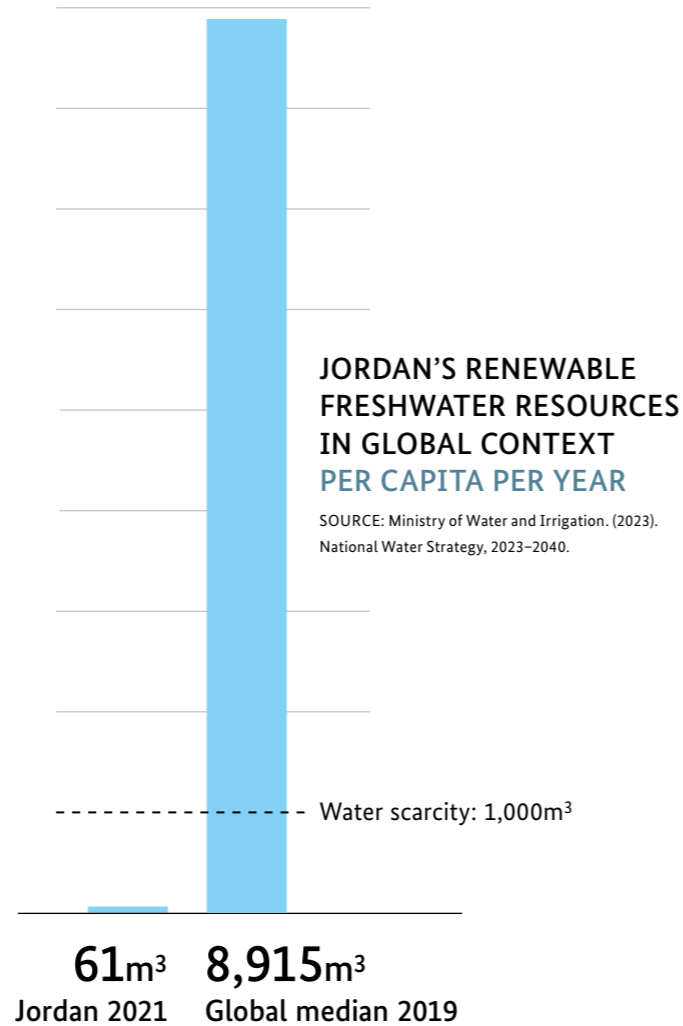
The world is facing a deepening water crisis. With each passing year – as a result of overuse, pollution, the destruction of natural ecosystems, and climate change – the freshwater supplies needed to sustain life on earth are coming under greater pressure. By 2030 there may be a 40 percent shortfall in water availability.¹ Parts of the world which have long been accustomed to plentiful water are now grappling with seasonal water scarcity. Countries already experiencing high or critical water stress – a group of nations home to ten percent of the world’s population – are facing an even more precarious water future. Against this backdrop, calls for bold and integrated action to tackle the global water crisis are getting louder² – and the experiences of countries which have long been on the frontlines of water scarcity are more relevant than ever.

Jordan is one such country. Extremely arid and endowed with limited natural water resources of its own, Jordan has few options for meeting its growing need for freshwater. It relies primarily on surface water, including flows from two transboundary rivers, and upon groundwater locked in aquifers deep under the desert. Available renewable water supplies fall far short of what is needed to supply a growing population with drinking water, to further develop the economy, and to expand the agricultural sector. Jordan is confronted by a persistent and widening water deficit, which it manages in part by pumping more groundwater than can be safely renewed.

As Jordan’s population continues to rise and the effects of climate change intensify, water scarcity is likely to become more acute. Scenarios for Jordan’s water future are sobering. In the absence of major interventions, over 90 percent of low-income households in Jordan could experience critical water insecurity by 2100.³ Economic growth, sustainable development, public health, food supply and social stability all depend upon the efficient stewardship of the country’s limited natural water resources.



← Mujib dam



← Water storage tanks on Jordanian rooftops

New pressure on water resources

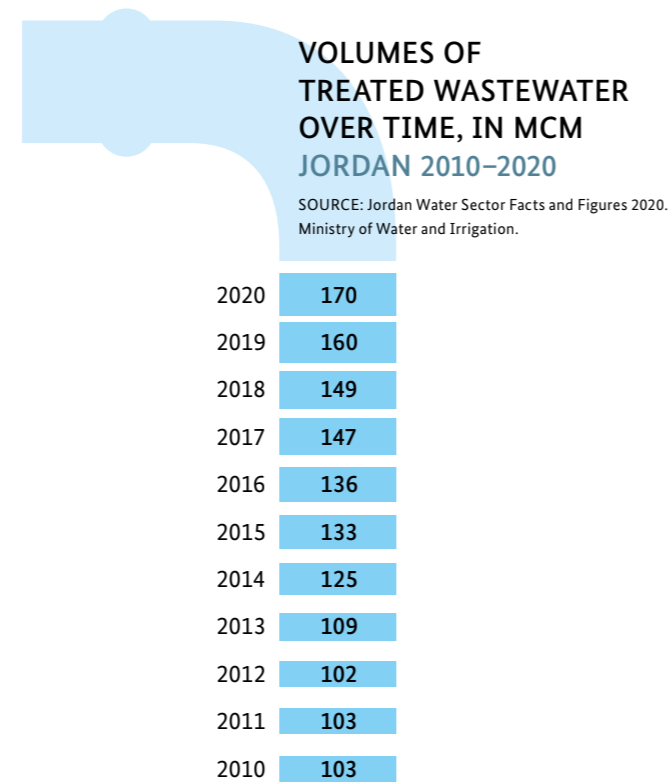
The Government of Jordan recognises these challenges and has long assigned a high priority to water resources management. The country’s main water institutions – the Ministry of Water and Irrigation, the Water Authority of Jordan and the Jordan Valley Authority (JVA) – have implemented various strategies to ensure water security. These include investments of more than 1.3 billion JOD to reduce water losses (Non-Revenue Water), as well as the development of new water sources. A major pipeline, for example, now carries large volumes of water from the Disi aquifer, in the south of the country, to Amman. Thanks to these and other efforts, 95 percent of Jordan’s population has access to safely managed drinking water – a key measure of progress towards the achievement of Sustainable Development Goal 6.⁴

Jordan’s resilience in the face of acute water scarcity is particularly striking in light of demographic trends. Between 2010 and 2020, the population of Jordan climbed from 6.9 to 10.9 million people.⁵ This reflects not only natural population growth, but also the arrival of over one million refugees from Syria who have found safety within Jordan’s borders, just as Palestinian, Iraqi and other refugees have done in the past. This population surge has exacerbated the existing water deficit and put enormous pressure upon the country’s water systems. For example, the domestic demand for water in the northern governorates, where most Syrian refugees live in host communities, has risen by more than 40 percent in recent years.⁶ As a result, water has emerged as a potential flashpoint between the Jordanian population and Syrian refugees. Measures which tackle water shortages are therefore important for social cohesion.

Increasing demand has not only accelerated the depletion of groundwater resources but also sharpened questions over how scarce water supplies are allocated. Municipal, industrial and agricultural users all require water, and are competing for shares from the same diminishing supply. The agricultural sector, despite its relatively small share of the economy, is the largest water user in the country. At the same time, half of Jordanian households receive less than 24 hours of piped water per week.⁷ As they make decisions about the allocation of water, the country’s water authorities must constantly balance the needs and interests of different groups of water users.

A world leader in the use of reclaimed water

In critically water-stressed countries like Jordan, every drop of water counts. Every drop needs to be used carefully – and then reused, again and again. The Government of Jordan has long understood this and has demonstrated a readiness to embrace innovations which can help it move closer to water security. One way it has done this is through the use of unconventional sources of water – non-freshwater resources which, following the necessary processing or treatment, can be made suitable for reuse. Such sources include brackish water, desalinated water and treated domestic wastewater, also known as ‘reclaimed water.’

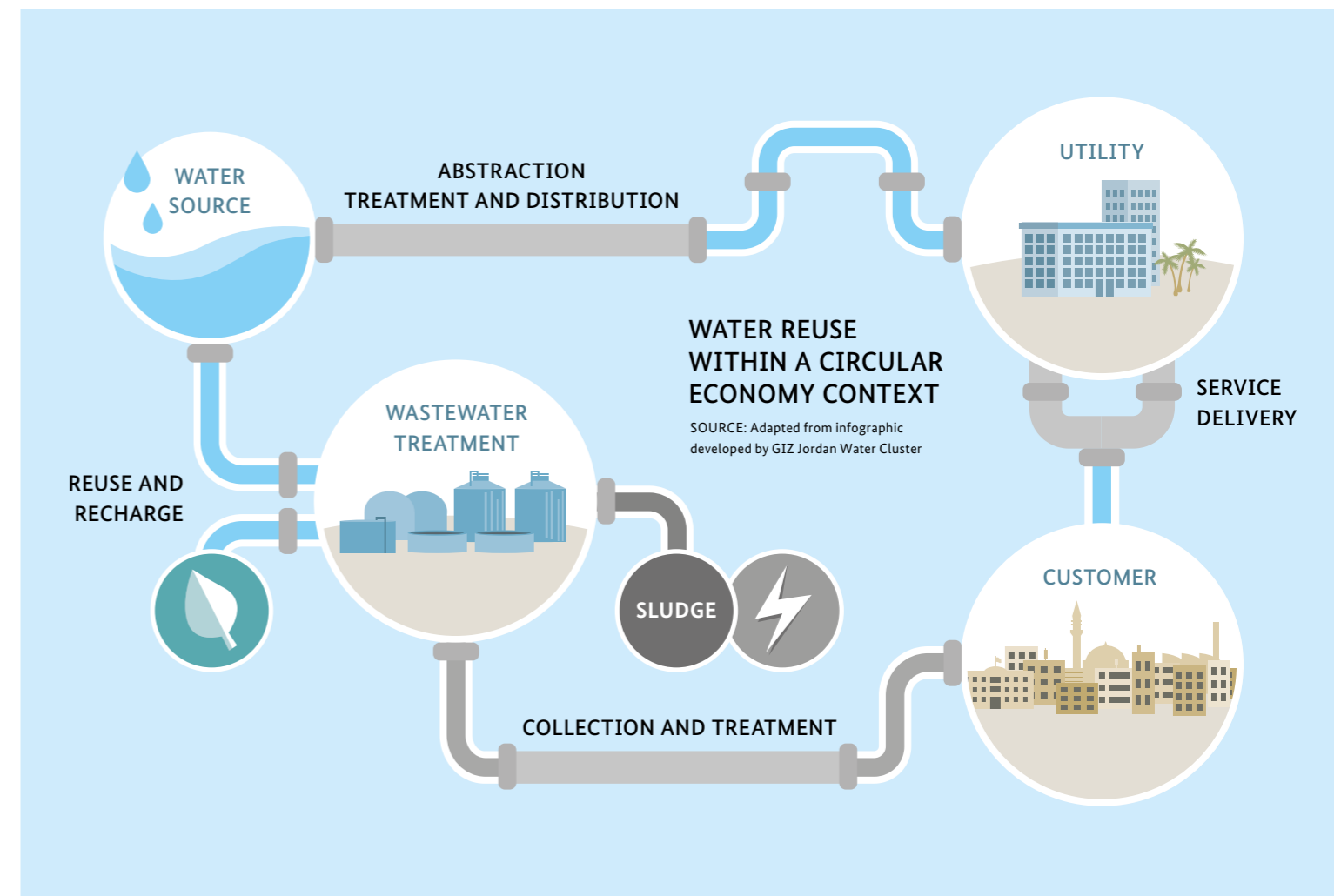


Over the past 15 years, Jordan has emerged as a world leader in the use of reclaimed water and has laid the basis for a circular water economy which links urban and agricultural areas. In 2020, the Water Authority of Jordan made 170 million cubic meters of treated wastewater available for reuse, primarily for restricted irrigation in the Jordan Valley. This represented more than 90 per cent of all the wastewater collected and treated in the country. That same year, reclaimed wastewater accounted for 31 percent of the water used by farmers for restricted irrigation countrywide⁸ – and 45 percent in the Jordan Valley⁹ – thereby freeing up large volumes of groundwater to be redirected to domestic users in urban areas.

While the reuse of treated wastewater cannot close Jordan’s water deficit, it can help to address a major water allocation challenge¹⁰ by preserving precious freshwater resources for essential human needs. At the same time, it provides an alternative source of water to secure farmers’ livelihoods and the country’s food supply. Wastewater – so often neglected – has emerged as an important contributor to Jordan’s resilience in the face of mounting water scarcity.

Wastewater as a resource

Wastewater has been traditionally seen as a problem to be dealt with – if it’s been thought about at all. Now, in more and more places, it is recognised as part of the solution to broader challenges such as water scarcity, pollution, environmental degradation and climate mitigation. This is part of an unfolding paradigm shift in how we think about and manage the by-products of human activity, from solid waste to wastewater.¹¹ Traditional ways of extracting, consuming and disposing of the remains of raw materials are making way for new approaches, based on circular economy principles, which seek to conserve, recover, recycle and reuse resources.



Wastewater has much to offer in this regard. When treated to standard, it not only produces effluent which can be safely reused, for specifically defined purposes, as an alternative source of water. It also generates large quantities of sludge – a nutrient-rich semi-solid organic material also referred to as biosolids¹² – which can be processed and transformed into energy carriers, industrial products or soil enhancers. Wastewater is also a valuable source of energy. At wastewater treatment plants which receive large volumes of influent, the energy inherent in wastewater can be captured, converted into biogas and then into electricity, and used to power treatment processes.

When a country chooses, as Jordan has, to regard wastewater as an asset to manage strategically, challenges can suddenly be transformed into opportunities. Rapid population growth and urbanisation are not just problems which can overwhelm existing municipal sanitation systems, but openings for resource recovery which can be seized.

Strategic investments in modern wastewater collection, treatment and reuse systems can lead to greater volumes of reclaimed water, biosolids, and energy. Unlocking the value inherent in wastewater can create jobs, improve the quality of life in urban areas, and protect the natural world. And when wastewater is managed with the needs of the agricultural sector in mind, it can also play a critical role in strengthening the so-called water-food-energy nexus.

What is needed is the political will to drive this paradigm shift forward, strong water sector institutions to manage it, and suitable legal and regulatory frameworks which protect the public interest. It requires sufficient financing to build and maintain complex wastewater infrastructure, and skilled human resources to operate it. Not least, it requires strong partnerships and cooperation with key stakeholders, such as farmers’ associations, and the backing of consumers and the public.

→ Greenhouse in the Jordan Valley



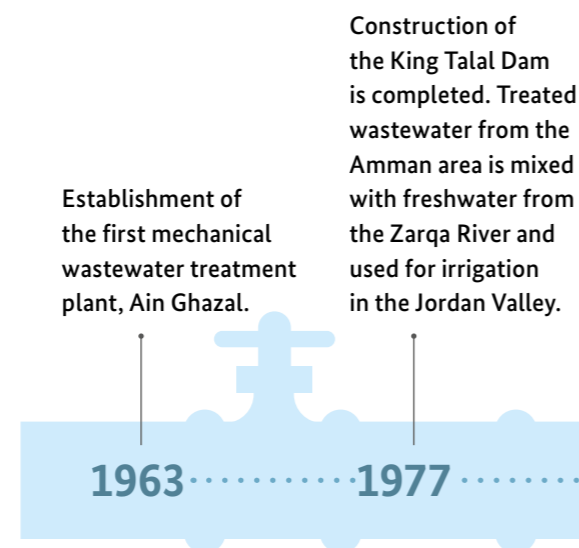
Jordan's wastewater journey, from the 1960s to today

Jordan has already succeeded in putting many of these elements in place, and continues to build on its achievements. The story begins in 1963 with the establishment of the country's first mechanical wastewater treatment plant, Ain Ghazal, to serve the population of Amman.¹³ First steps towards reuse were taken in the late 1970s, when treated wastewater from the stabilisation ponds at the Khirbet As Samra treatment plant in Greater Amman began to be mixed with water from the Zarqa River. This blended water was channelled to the King Abdullah Canal, the main source of irrigation water for farmers in the Jordan Valley. The 110-kilometer-long canal runs the entire length of the Valley from north to south, carrying freshwater drawn from the Yarmouk River, Lake Tiberias, dams and wellfields.¹⁴ Just above the point where the blended water from Greater Amman flows into the canal, freshwater is diverted and piped to Amman for domestic use.

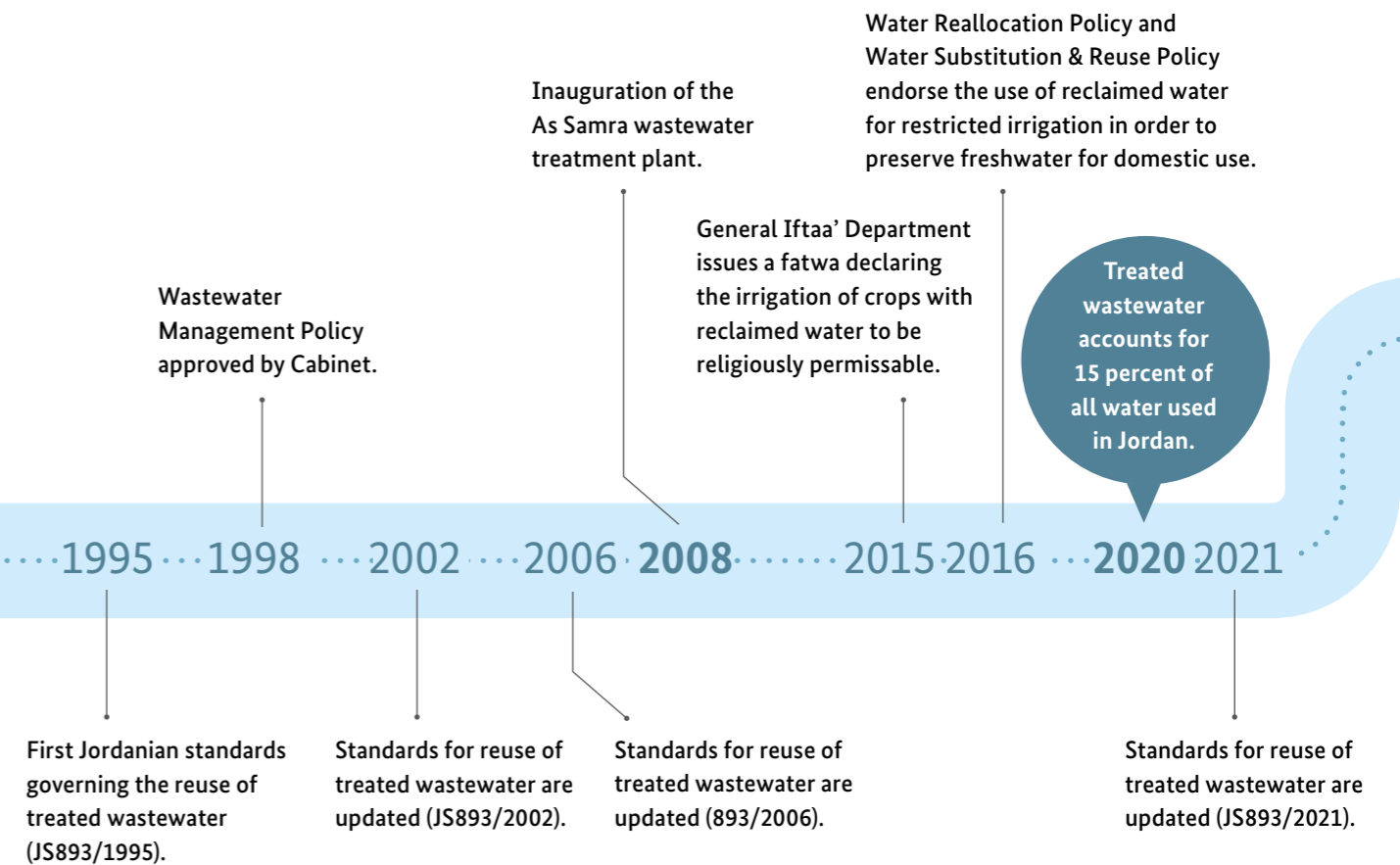
In the early 1990s the journey picked up pace with the adoption of the first national standards for the reuse of treated wastewater.¹⁵ Around the turn of the millennium a series of projects studied the application of marginal water sources, including brackish water and treated wastewater, in close cooperation with farmers and Water Users' Associations in the Jordan Valley. These informed guidelines about the safe use of treated wastewater and helped to institutionalise knowledge about safe reuse within Jordan's agricultural institutions. Acceptance among farmers grew and reclaimed water gradually became the basis for sustainable agriculture.¹⁶

The current era of reclaimed water began in 2008, with the inauguration of the new As Samra wastewater treatment plant west of Amman. Commissioned by Jordan's Ministry of Water and Irrigation and constructed with financial support from the United States Agency for International Development (USAID) and the Millennium Challenge Corporation,¹⁷ the As Samra plant uses aeration tanks and activated sludge technologies capable of treating huge volumes of wastewater to a higher standard than was previously possible using stabilisation ponds. A biogas digester and hydropower turbines in the pipelines flowing to and from As Samra make it possible for the plant to cover approximately 90 percent of its energy needs.¹⁸ As Samra marked the first major adoption of these wastewater treatment technologies in Jordan. It demonstrated how Jordan's wastewater sector could generate more and better effluent for reuse, in a more energy efficient, climate-friendly way.

Since this time, treated wastewater has assumed increasing importance in Jordan's water resource strategies, and the technologies introduced at As Samra are being extended to other parts of the country. Jordan's religious authorities, through the General Iftaa' Department, issued a fatwa in 2015 declaring it permissible, from a religious point of view, to irrigate with reclaimed water if relevant standards are met.¹⁹ The 2016 Water Substitution and Reuse Policy officially endorsed the widespread use of treated wastewater in order to free up freshwater supplies for domestic use.²⁰ By 2020, treated wastewater accounted for 15 percent of all the water used in Jordan. As impressive as this is, the country's water authorities believe that this can be – and needs to be – even higher.



↑ Aerial view of the As Samra wastewater treatment plant, 2016



Ambitious aims for the future

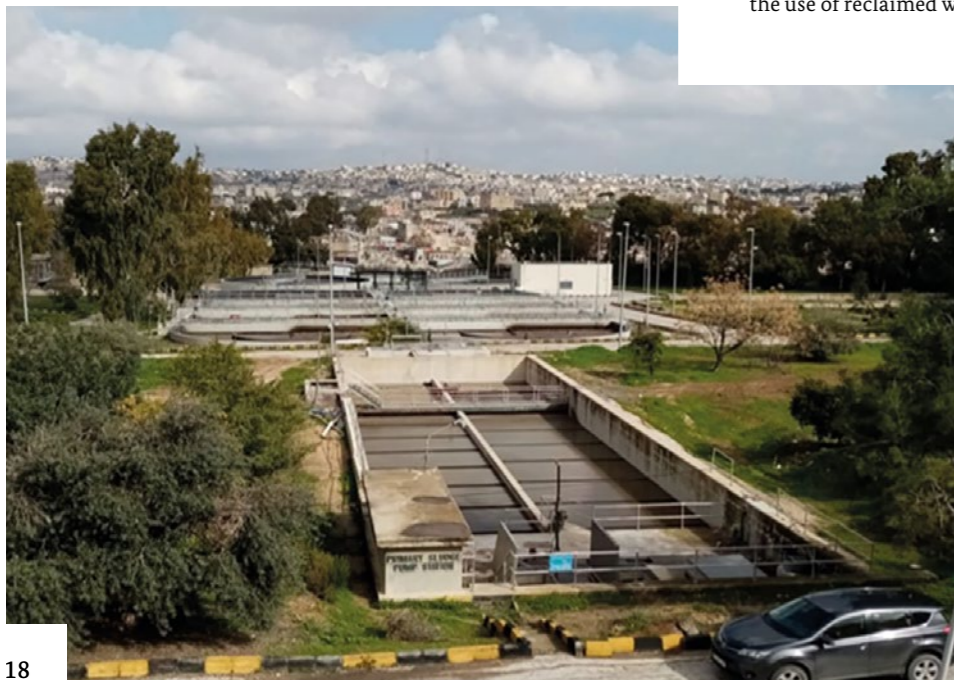
The Ministry of Water and Irrigation has set ambitious goals for the coming years: it aims by 2040 to nearly double the amount of non-conventional water which is used for irrigation in the Jordan Valley and highlands.²¹ This will require, first and foremost, collecting and treating more wastewater. Presently, 66 percent of Jordanian households are connected to sewer networks; by 2040, the share should rise to 80 percent.²² To be reused for restricted irrigation, the wastewater must first be treated to Jordan's strict national standards* and is then transported, sometimes over long distances, to agricultural areas. All of this should be done in the most energy efficient and climate-friendly way possible – to reduce wastewater-related emissions as well as operating costs.

The technologies required to achieve these aims exist. Many of them are already in use in Jordan, not only at the flagship As Samra plant, but at a growing number of other treatment plants as well. However, investments in technologies and infrastructure alone are not enough. To work sustainably, they need to be deployed in an enabling financial, institutional and regulatory environment.

With this in mind, Jordan is pursuing institutional reforms which will strengthen governance and oversight in the water sector. These reforms are aimed at safeguarding water security, putting the water sector onto a more sustainable financial footing, and ensuring accountability in the delivery of water

and wastewater services. A major step forward has been the establishment of three independent water utilities – Aqaba Water Company (in 2004), Jordan Water Company Miyahuna (in 2007) and the Yarmouk Water Company (in 2011) – which operate the country's water and wastewater infrastructure and deliver retail services under management contracts from the Water Authority of Jordan. This delegation of functions is allowing the Water Authority of Jordan to concentrate on strategic planning, the bulk provision of water supply, contracts and outsourcing, and quality assurance. An important objective for the coming years is to continue progress towards the establishment of an independent regulator for the water sector which will monitor the financial and operational performance of the water utilities.

* JS 893/2021 is the national standard for the reuse of treated domestic wastewater. JS1766/2014 governs the use of reclaimed water for irrigation.



← Central Irbid wastewater treatment plant

A long-standing partnership

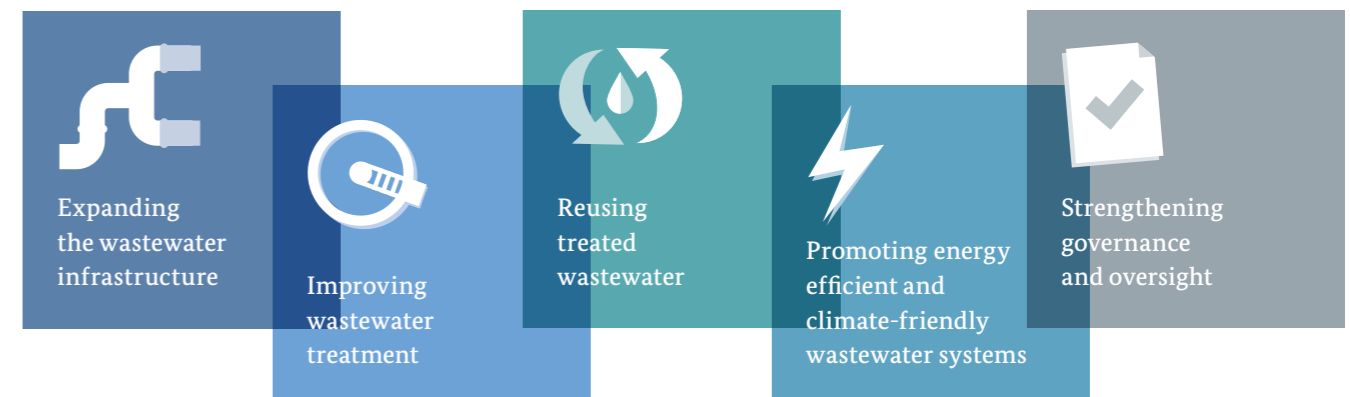
Germany is a key partner to the Government of Jordan as it works to transform its wastewater sector in a more sustainable, climate-friendly direction. For more than 60 years, Germany's Federal Ministry for Economic Cooperation and Development (BMZ) has been supporting Jordanian partners in the water sector – the Ministry of Water and Irrigation, the Water Authority of Jordan, the Jordan Valley Authority and, most recently, the three water utilities – to achieve their aims.

German development cooperation with Jordan takes the form of both financial assistance, which is implemented by KfW Development Bank, and technical assistance, which is administered by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH as well as the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) and the Physikalisch-Technische Bundesanstalt (PTB).

Over the past 15 years, wastewater projects have come to occupy an increasingly prominent role in German-Jordanian development cooperation (see Annexes 1 and 2). This publication systematically presents what has been achieved and learned through this cooperation, focusing on five major areas (see below).

The next chapter addresses each of these areas in turn, presenting the strategies pursued by the Government of Jordan and the contributions which German financial and technical cooperation have made to their realisation.

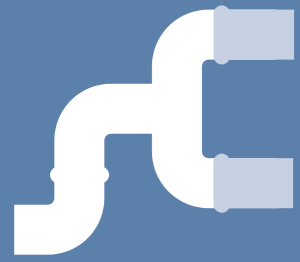
This publication focuses on 5 major areas:



02

Unlocking potentials: Focus areas of German-Jordanian cooperation





Expanding the wastewater infrastructure



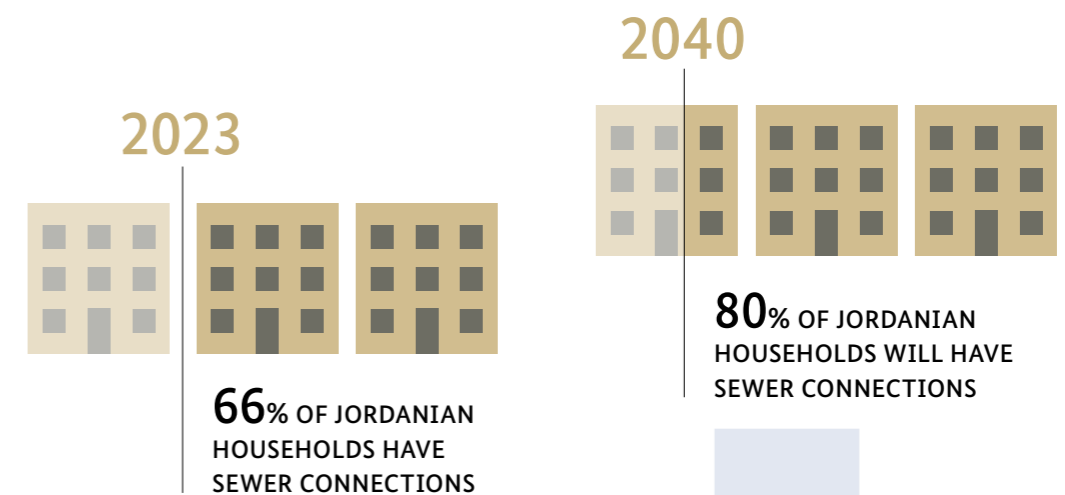
➤ Downtown Amman

Jordan's approach to wastewater collection and treatment

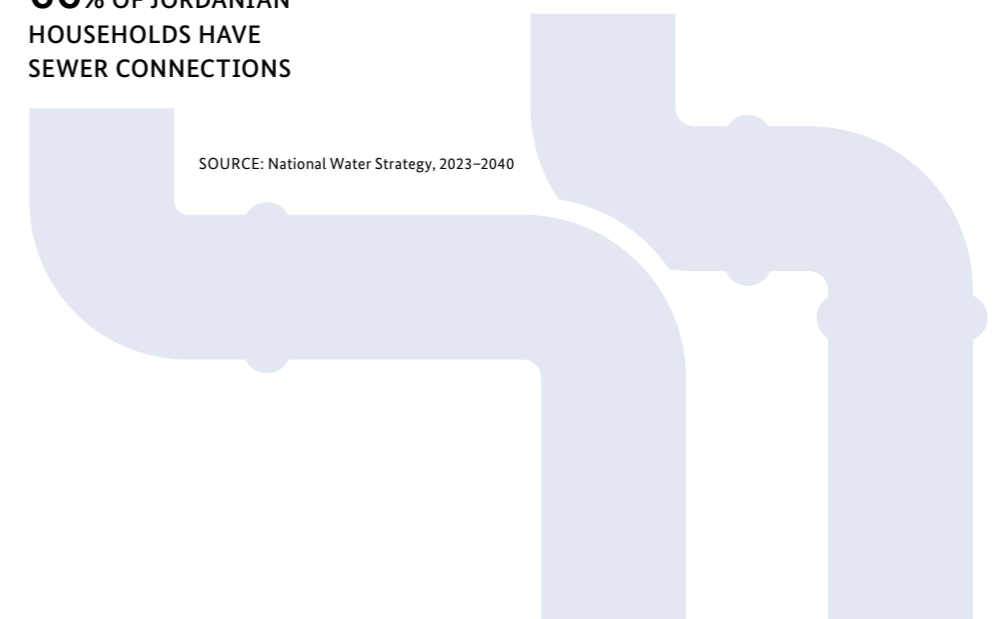
The safe management of human waste is important for protecting people's health and the natural environment. Despite dramatic population growth, Jordan has maintained and improved access to safely managed sanitation services for its population. In 2020 over 88 percent of Jordanians used safely managed sanitation services and a hand-washing facility with soap and water (SDG 6.2.1), up from 84 percent in 2016.²³

The Government of Jordan relies upon centralised wastewater systems as its main sanitation intervention. Centralised systems collect wastewater from individual households, businesses, schools, religious institutions, factories and office buildings and transport it with the help of pumping stations through sewer pipes to wastewater treatment facilities. Two-thirds of Jordanian households have sewer connections,²⁴ although coverage rates vary widely across the country.²⁵ In 2022 these networks carried 200 million cubic meters of wastewater²⁶ to 29 wastewater treatment plants for processing.

Centralised systems are particularly suitable for built-up areas where large volumes of wastewater cannot be contained and treated safely on-site, as is the case in rural or less densely populated areas. They protect soil and groundwater from contamination, and capture wastewater for treatment, thereby making more effluent available for reuse.



SOURCE: National Water Strategy, 2023-2040





← Fuheis wastewater treatment plant

A well-developed system comes under pressure

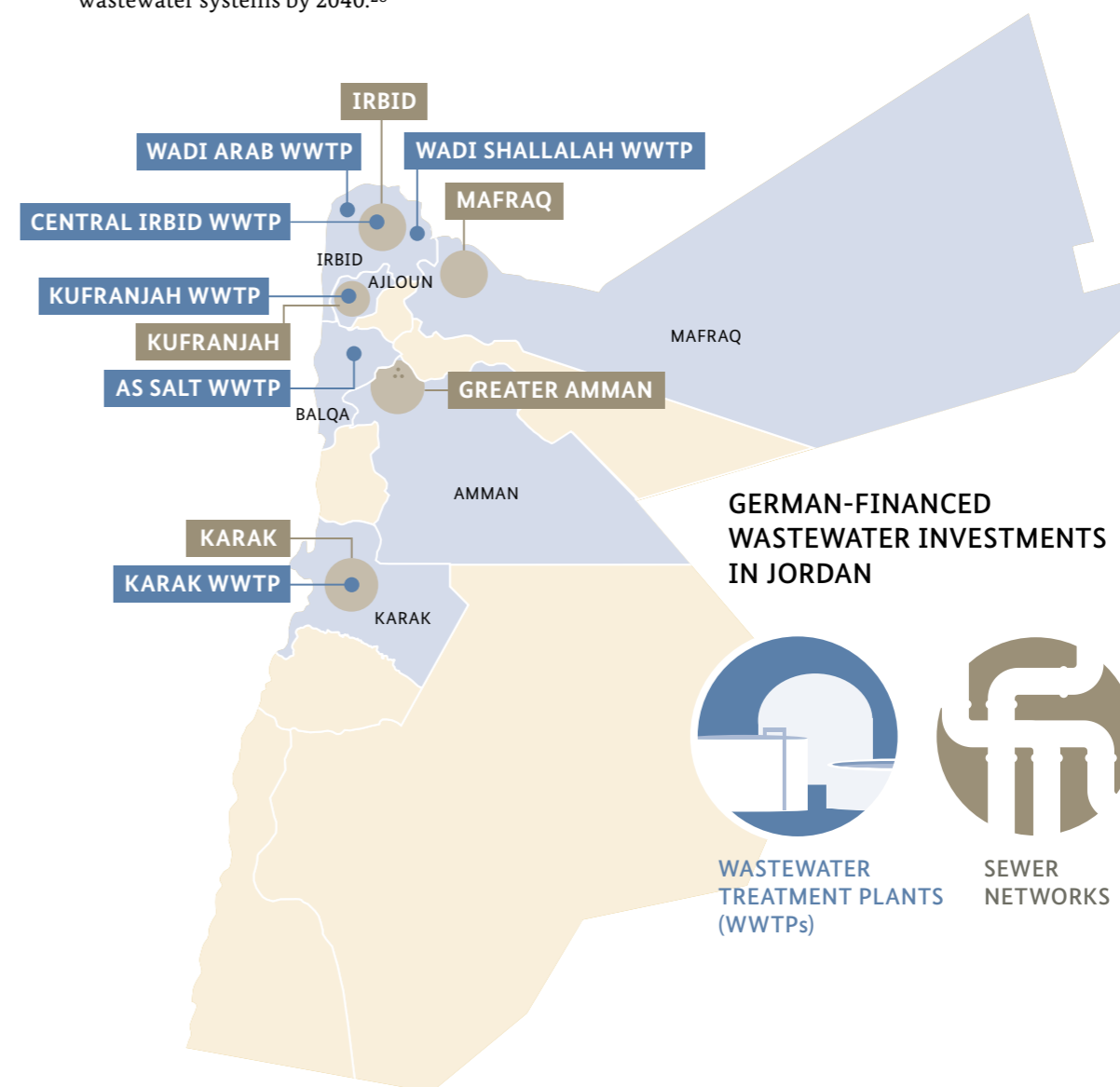
Despite their many benefits, sewer networks and wastewater treatment plants take a long time to plan, and are costly to construct and operate. Once in place, they require constant preventive maintenance – and immediate repairs when things go wrong. Pipes can develop leaks; illegal storm water connections can cause sewer mains to overflow. Climate change-induced stresses, such as extreme heat, can exacerbate corrosion within sewer networks if not addressed through adaptive planning. Sometimes, as in the case of unexpected population growth, planning assumptions can be overtaken by real-life events. If treatment plants exceed their design capacities sooner than envisioned, their overall performance can suffer as a result.

Jordan's well-developed wastewater systems are affected by these challenges. Certain treatment plants are outdated and urgently need to be upgraded. Others are simply overloaded. In northern Jordan, for example, the dramatic increase in population following the start of the war in Syria and the resulting refugee influx has placed great strain upon existing sewer networks and wastewater treatment plants. These areas already had some of the lowest wastewater connection rates in the country, ranging from 17% in Mafraq to approximately 50% in Irbid.²⁷ The arrival of hundreds of thousands of refugees has increased the urgency to expand wastewater systems in this part of the country.

Investments in sewer networks and treatment plants

Germany is a major financier of investments in wastewater infrastructure in Jordan. Through grants and loans from KfW Development Bank, it is supporting the Ministry of Water and Irrigation to construct more than 850 kilometers of new sewer networks. When all these projects are completed, the networks will serve an additional population of 470,000 people in the greater Amman area, as well as in the Ajloun, Irbid and Mafraq governorates in the north and in Karak governorate in the south. Investments in sewer networks allow new localities and areas to be connected to existing systems. This helps to bring the country closer to reaching the Ministry of Water and Irrigation's objective of connecting 80 percent of the population to centralised wastewater systems by 2040.²⁸

KfW Development Bank is also supporting Jordanian partners to construct, upgrade or rehabilitate six wastewater treatment plants in the Ajloun, Balqa, Irbid and Karak governorates. As a result of these investments, some of which are still underway, these plants collectively will be able to receive and treat 2.5 times more influent per day than they were able to in the past. This is an important contribution to the Ministry of Water and Irrigation's aim to generate more treated wastewater.



A focus on the northern governorates

WASTEWATER INFRASTRUCTURE IN IRBID GOVERNORATE

Much of Germany's support for wastewater infrastructure has been concentrated in the north of the country, and particularly in Irbid governorate. Well before the start of the conflict in Syria, KfW Development Bank financed the construction of the Wadi Shallalah wastewater treatment plant. Following the example of As Samra, Wadi Shallalah was designed with the aim of generating treated wastewater which could be blended with freshwater and used for irrigation in the Jordan Valley. It employs treatment and pumping technologies and sludge digestion systems which reduce the plant's operating costs (for example, by requiring less oxygen) and allow for energy recovery.

Wadi Shallalah was inaugurated in 2013. Because the treatment plant and associated sewer networks were already in place when refugees began to arrive into the area, it was possible to connect newly constructed buildings relatively quickly. In the past decade, as the population in the area has surged, German development cooperation has supported upgrades to two more treatment plants (Central Irbid and Wadi Arab) and is building a pipeline to combine the effluent from the three plants, as well as the Ramtha wastewater treatment plant, and transport it to the Jordan Valley, where it will be blended with freshwater and used for irrigation.

The construction of new sewer networks in greater Irbid, mentioned above, will allow wastewater from rapidly urbanising areas to be collected and transported for treatment to these plants. Similar sewer expansions are underway in Mafraq, another community which hosts large numbers of refugees.



↳ The Wadi Shallalah wastewater treatment plant, in Irbid Governorate (top and bottom)



← Za'atari Refugee Camp in northeast Jordan

A WASTEWATER COLLECTION SYSTEM FOR THE ZA'ATARI REFUGEE CAMP

The Government of Jordan and host communities have demonstrated remarkable generosity in their response to the Syrian refugee crisis. At the same time, the task of accommodating and providing services to more than a million refugees presents significant financial, operational and logistical challenges. Contributions from United Nations agencies, development partners, international organisations and NGOs have complemented the support provided by the Government of Jordan.

As part of its contribution to the Jordan Response Plan to the Syria Crisis, Germany supported the construction of a localised sewer network in the Za'atari Refugee Camp, which was established in 2012 by the United Nations High Commissioner for Refugees (UNHCR). As the population of the camp swelled in the early years of the Syrian conflict, a humanitarian crisis threatened to unfold. Families, including many young children, were living in unhygienic conditions. And because the camp was built on top of an important aquifer, there was a high risk of groundwater contamination as a result of the absence of safely managed sanitation.

The emergency response measure financed through KfW, and executed by the United Nations Children's Fund (UNICEF) in cooperation with the Water Authority of Jordan and the Yarmouk Water Company, made it possible to safely transport wastewater from clusters of households to the camp's own wastewater treatment plant. The sewer network, which was completed in 2018, has reduced the risk of disease transmission and environmental contamination, and improved living conditions for the camp's 82,000 residents.²⁹

IMPROVING ACCESS TO PUBLIC SANITATION FACILITIES IN HOST COMMUNITIES

The Sanitation for Millions programme, a global initiative funded by BMZ and the Bill and Melinda Gates Foundation, works to improve access to sanitation and hygiene for the most vulnerable members of society. In many communities in Jordan, there is only limited access to functional, hygienically maintained public sanitation facilities. People with disabilities, elderly people, and women and girls face particular difficulties, as the infrastructure which does exist does not meet their special needs.

Members of the public often rely on mosques and other religious facilities to fill this gap in the sanitation infrastructure. Sanitation for Millions worked with the Ministry of Awqaf, Islamic Affairs and Holy Places to upgrade toilets and sanitary units at seven mosques in host communities in Irbid and Mafraq.

Altogether it constructed 73 new accessible and female-friendly toilets, repaired pipes and improved wastewater drainage systems. In addition, it trained more than 900 *muezzins* – the individuals who, in addition to proclaiming the call to daily prayers, are responsible for operation and maintenance in mosques – in basic plumbing skills. The programme also equipped mobile maintenance teams to handle medium-sized repairs and maintenance issues.



Improving wastewater treatment



7 An operator taking a wastewater sample

Challenges to an essential service

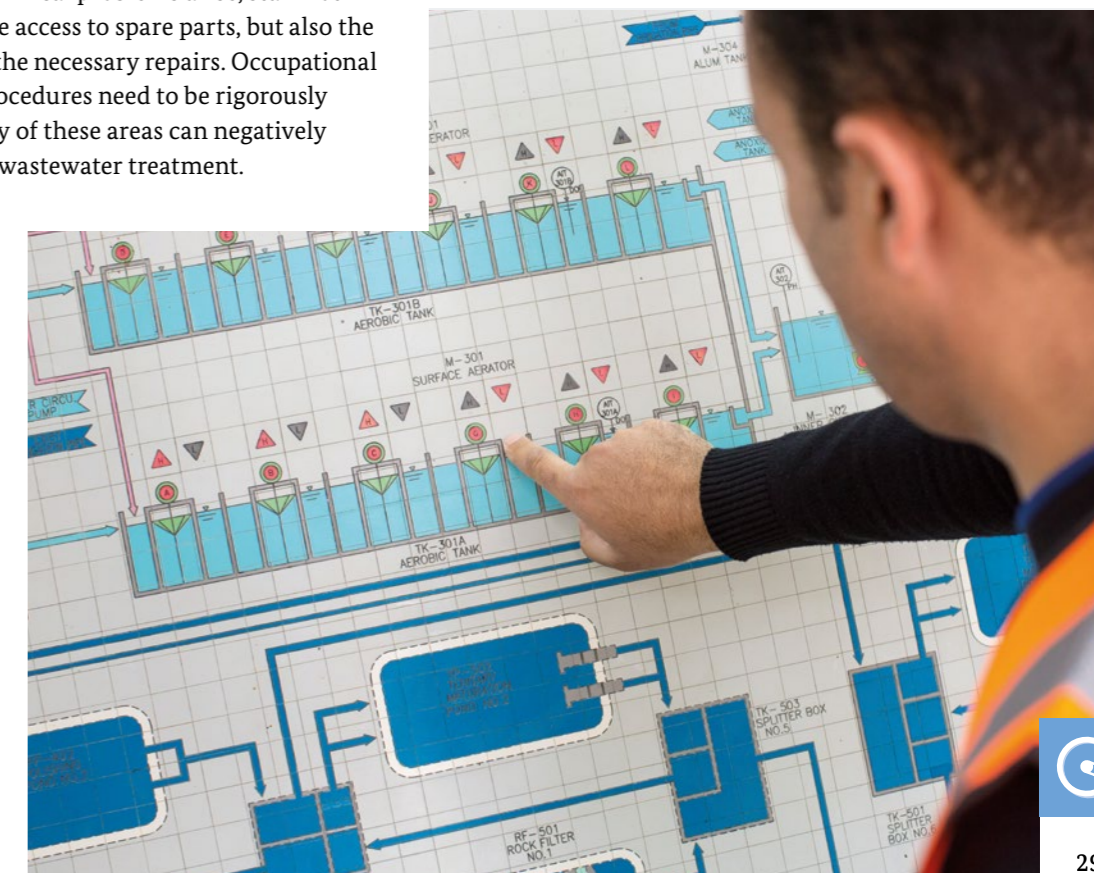
Jordan's 29 wastewater treatment plants provide an essential service. Every day, on average, they accept more than 500,000 cubic meters of sewage and turn it into effluent and sludge which can be reused or disposed of without risk to human health or the environment.

Another major challenge is financing. Wastewater services are expensive to deliver, while the revenue generating potentials of wastewater – for example, the sale of treated wastewater, biogas and sludge-based products – are not yet being widely utilised in Jordan. The small portion of the water tariff which is allocated to wastewater services is both insufficient to cover actual costs and not ringfenced within the water utilities' budgets. As a result, wastewater services are chronically underfinanced. This affects the ability of the utilities to procure needed spare parts and supplies, to contract out repairs which cannot be handled in-house, or to make small investments to improve operations or energy efficiency.

The treatment plants play this role under challenging circumstances. As the previous section described, some of the plants are outdated and need to be modernised. Others are receiving far more influent than they were originally designed to manage and are in urgent need of expansion. But even in recently upgraded plants, where influent volumes lie well within design parameters, difficulties in day-to-day operations sometimes undermine overall performance.

One reason for this is that wastewater treatment plants are complex to run. They require experienced engineers and technicians. Equipment must be operated according to manufacturer specifications. Preventive maintenance must be performed regularly in order to keep equipment running properly and efficiently. When technical problems arise, staff not only need immediate access to spare parts, but also the know-how to make the necessary repairs. Occupational health and safety procedures need to be rigorously followed. Gaps in any of these areas can negatively affect the quality of wastewater treatment.

↓ SCADA (Supervisory Control and Data Acquisition) systems are used to monitor wastewater treatment processes



A quality management system for wastewater treatment plants

Wastewater treatment plants must be managed well if the anticipated benefits of large capital investments in wastewater infrastructure are to be realised. For this reason, the Water Authority of Jordan has adopted Technical Sustainable Management (TSM) as a quality management system for improving the performance and processes at wastewater treatment plants and ensuring that they are complying with standards.

SYSTEMATISING AND IMPROVING TREATMENT PROCESSES

TSM, which was introduced to Jordan with support from GIZ, offers a systematic approach to quality management that is aimed specifically at the managers of wastewater treatment plants. At the heart of TSM is a catalogue of more than 130 requirements – derived from Jordanian laws, regulatory documents, and international best practice – covering six essential areas:

- Human resources
- Occupational health and safety
- Operations
- Maintenance
- Quality assurance/control
- Energy efficiency

Wastewater treatment plant managers use the catalogue of requirements as a guiding framework for systematising administrative and technical processes. Periodically, the Water Authority of Jordan sends trained inspectors to wastewater treatment plants to check compliance with the catalogue of requirements. Those treatment plants which pass the on-site inspections are awarded official certification.

The strength of TSM is that it supports the treatment plant managers to run their facilities as efficiently as possible with the resources that are available to them. For example, it steers treatment plant operators towards the establishment of routines and away from ad hoc ways of working. It demonstrates the benefits of consistently documenting work processes, technical problems and repairs, and encourages more formalised approaches to personnel management. TSM gradually improves underlying processes and systems within wastewater plants, and motivates staff to work together as teams.

ADAPTING TECHNICAL SUSTAINABLE MANAGEMENT TO JORDAN

TSM was first developed in Germany, by the German Association for Water, Wastewater and Waste (DWA), as *Technisches Sicherheitsmanagement* ('Technical Safety Management'). It was subsequently adapted and introduced in Egypt, where it has proven highly successful. With support from GIZ, the Water Authority of Jordan has tailored TSM to the needs of the Jordanian wastewater sector. It developed a Jordanian requirements catalogue, supported seven treatment plant managers in the northern governorates to comply with the requirements, and set up and tested out inspection processes. TSM processes were further improved based on these first experiences.

In 2022 a TSM department was established within the Water Authority of Jordan and the approach began to be rolled out countrywide. Since this time, ten wastewater treatment plants have been officially certified.

Now that TSM is fully institutionalised, it is helping the Water Authority of Jordan to identify common technical problems encountered at wastewater treatment plants, the reasons for differences in performance between facilities, and investment opportunities and priorities. It is also important for fostering accountability and trust. Inspections and certification are a way that water utilities can demonstrate their commitment to high quality service delivery and build their credibility with the public.



↑ TSM inspectors check compliance with a detailed catalogue of requirements



← TSM inspection at the Jerash East wastewater treatment plant

Critical support for Operations and Maintenance

When it comes to wastewater infrastructure, the forces of time and nature are merciless: as soon as a treatment plant is built or upgraded, it immediately begins to deteriorate. Operations and Maintenance (O&M) – the regular actions that are taken in the use and upkeep of property and equipment – slows down this process of degradation. It helps to ensure that a physical asset performs reliably throughout its expected useful life.

OPERATIONS AND MAINTENANCE HELPS TO SECURE INVESTMENTS

Jordan's three water utilities – Aqaba Water Company, Miyahuna, and Yarmouk Water Company – are responsible for Operations and Maintenance at all wastewater treatment plants across the country, with the exception of As Samra.* German financial and technical development cooperation agencies work directly with the utilities to support Operations and Maintenance, where necessary.

Companies contracted to construct or upgrade wastewater treatment plants with financing from KfW are generally required to operate the plants for two years following completion of the physical measures. In such cases, private sector operators train water utility staff to work with the new technologies and systems so that they are ready to run them sustainably following the conclusion of the contract. On the technical cooperation side, GIZ provides demand-driven on-site coaching and mentoring at wastewater treatment plants, particularly those operated by Yarmouk Water Company. This includes everything from training laboratory technicians to improve the reliability of test results to working with entire teams on the implementation of standard operating procedures and preventive maintenance.

* The As Samra wastewater treatment plant is operated by a private company under a 25-year Build-Operate-Transfer (BOT) contract with the Water Authority of Jordan.

← The maintenance workshop at the Wadi Hassan wastewater treatment plant

SUSTAINING OPERATIONS DURING THE COVID-19 PANDEMIC

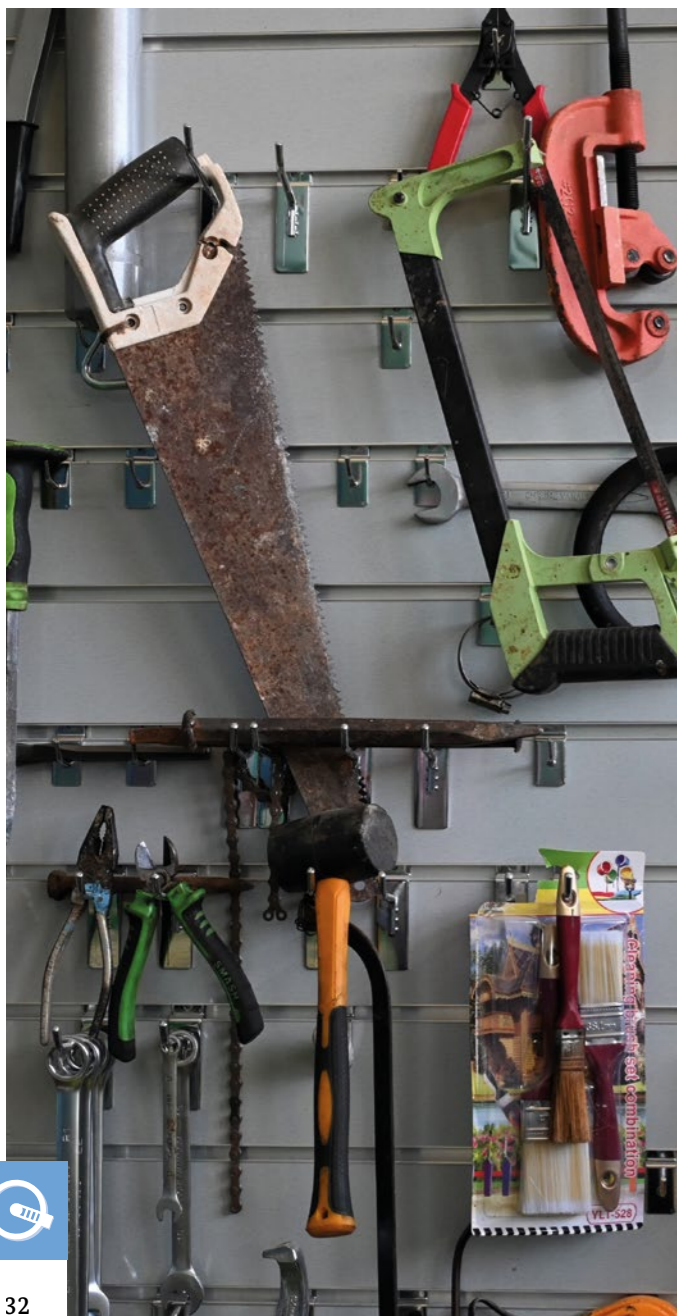
Wastewater treatment plants are too important to fail. During the COVID-19 pandemic, the employees of wastewater treatment plants were considered essential workers and were exempted from strict national lockdowns. Their colleagues on the retail side of operations, including billing and collections, were not. This led to a precipitous drop in revenues and severely compromised the utilities' ability to keep the wastewater treatment plants running.

As part of its support for Jordan's emergency response to COVID-19, German development cooperation made resources available via GIZ to plug critical gaps by procuring spare parts and essential consumables, such as chlorine. Through KfW it initiated a performance-based financing programme to help the water utilities sustain their regular operations. A portion of the disbursements was linked to the operational performance of wastewater treatment, measured via effluent quality.

A second phase of this programme supports water utilities to finance investments that can further improve their performance. Small, but impactful upgrades such as replacing sewage effluent pumps and aeration systems, improving sludge lines, and updating stone traps can improve treatment plant performance. Such investments improve Operations and Maintenance, thereby contributing to the longevity of equipment and other physical assets.



↑ Participant in a practical training course at the Water Training Center



Development of the wastewater workforce

Jordan has a large supply of well-trained engineers and plentiful young people keen to enter technical trades. However, more needs to be done to create a clear framework for professional qualification and human resource development in the water and wastewater sector. This is essential if the sector aspires to retain qualified personnel, who might otherwise opt for higher-remunerated work abroad or with private companies, and to ensure a workforce which is fit for the challenges of the future. Greater flexibility in hiring practices, which are governed by civil service regulations, would also allow the water utilities to have more autonomy over personnel decisions.

The performance of wastewater treatment plants is affected by human resource challenges. Certain functional areas have few experienced staff.³⁰ Some employees do not bring the right skills for the roles they are expected to perform. Others essentially learn on the job, in the absence of formal on-boarding procedures, mentoring and supervision.

In an effort to address some of these limitations, Germany supports systemic initiatives to develop a water and sanitation workforce with the right skills to perform their roles, as well as opportunities to upgrade their qualifications. GIZ works with the Water Authority of Jordan and the water utilities to introduce sector-wide human resource development approaches which can identify training needs, formulate plans to act on gaps, and enable horizontal learning and exchange between water sector institutions.



SECTOR-WIDE APPROACHES TO HUMAN RESOURCE DEVELOPMENT

The Training Needs Assessment (TNA) methodology offers a way to identify skills gaps across different job categories, both managerial and operational. Proceeding systematically across the workforce, TNAs consider existing competencies against the requirements of job descriptions and generate a detailed picture of training needs.

The Human Resource Development (HRD) approach helps human resource personnel and managers of water utilities to draw up plans to address identified gaps and to improve organisation-wide effectiveness. HRD has been used to bring together personnel from all three water utilities to align and improve certain practices and to deepen collaboration in the pursuit of more effective water and wastewater service delivery.

The Water Training Center in Amman hosts a diverse range of theoretical and practical training courses for water and wastewater workers. This facility, which belongs to the Water Authority of Jordan, was fully refurbished with support from GIZ in 2022. In addition, GIZ supports the Training Department at the Water Authority of Jordan to institutionalise the Water Training Center as the national training institution for the entire water sector.

A learning management system offers opportunities for horizontal knowledge sharing and exchange between water sector institutions through an integrated platform for blended learning.

↑ Classroom training at the Water Training Center

Thanks to a Memorandum of Understanding concluded in 2020 between the three water utilities and the Water Authority of Jordan, it is now possible for utilities to send their staff to visit other companies, to set up job shadowing opportunities in their own companies, and to participate in training courses at the Water Training Center without additional approvals or lengthy paperwork.



← Maintenance and repair training at the Water Training Center



Reusing treated wastewater



➤ Agriculture in Jordan still uses large amounts of freshwater

A major alternative source of water

The inauguration of the As Samra wastewater treatment plant in 2008 was a game changer in terms of the quantity and quality of reclaimed water available in Jordan. As Samra made it clear that reclaimed water could constitute a major alternative source of water – and that this water could be transported at relatively low cost, with help from topography, to low-lying agricultural areas. It also showed that modern treatment technologies could produce effluent which satisfied the country's strict standard for reuse of domestic wastewater, JS 893/2006 (now JS 893/2021). Effluent which meets this standard can be used for agricultural purposes, but it may not be mixed with any water which will eventually be used for drinking.

Today, As Samra produces approximately 70 percent of all treated wastewater in Jordan³¹. It is blended with freshwater from the Zarqa River in the King Talal Dam and then channelled to the King Abdullah Canal, where it is used by farmers in the southern Jordan Valley. The effluent generated by smaller wastewater treatment plants operated by Miyahuna and the Yarmouk Water Company is generally used locally. Farmers secure licenses from the Water Authority of Jordan to purchase and use the water; the Water Authority collects and keeps the revenues. Aqaba Water Company sells its treated effluent directly to local customers for use particularly in landscaping and industry. At present less than 2 percent of treated wastewater in Jordan is reused by industry, but there is room for this to grow in the future.³²

↓ The King Talal Dam in Jerash Governorate is the largest in Jordan



A new reuse system in the north

The Water Authority of Jordan is expanding reuse systems so that effluent generated in one part of the country can be used in another.

In Irbid governorate, where German investments at the Central Irbid, Wadi Arab and Wadi Shallalah wastewater treatment plants have improved the quality of treated wastewater being produced, KfW is also financing the infrastructure needed to transmit it to areas where it can be reused. Once operational, a new effluent pipeline will collect the treated wastewater from the three treatment plants, as well as the nearby Ramtha wastewater treatment plant, and carry it to the northern Jordan Valley where it will be blended with freshwater from the King Abdullah Canal. Along the way, the effluent will flow through two small hydropower plants, currently under construction, and generate electricity which will be used to power a pumping station and one of the treatment plants.

These investments in the reuse system aim to harness the growing volume of reclaimed water from one of the country's fastest growing regions and deliver it to farmers in the central and northern parts of the Jordan Valley who have thus far had little access to reclaimed water.

↓ Wadi Shallalah wastewater treatment plant



← The greywater recycling system at the Ja'far ibn Abi Talib mosque in Mazar collects water from ablution facilities (left) and treats it so that it can be used to water the gardens (right) and for outdoor cleaning

Reclaiming water used for ritual washing at holy places

While conversations about reclaimed water often center on wastewater treatment plants, given the large volumes of water they can produce, smaller systems also have an important role to play. With support from GIZ, six mosques and shrines in Balqa, Karak and Mafraq governorates have introduced 'greywater' recycling systems* which capture and treat water used for ritual washing so that it can be used to irrigate gardens and clean outdoor spaces.

The systems divert the water from the sinks and drains in men's and women's ablution areas into a sedimentation tank in the ground. From there it is pumped into a sand filter, filled with layers of natural materials, which removes impurities. The resulting treated water is of good enough quality to be used to water plants and to clean walkways and courtyards.

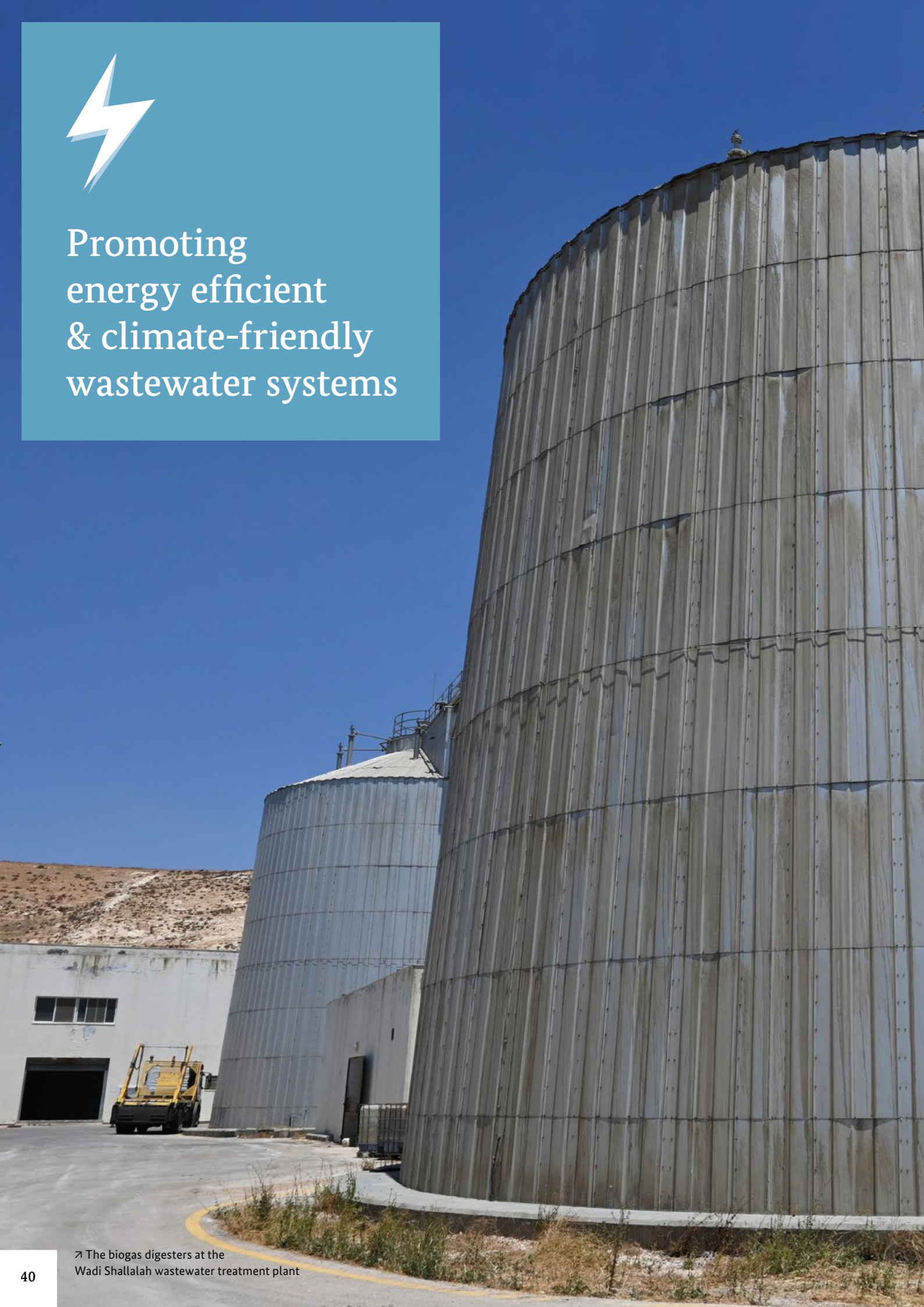
The Ja'afar ibn Abi Talib mosque, in Mazar, Karak governorate, is the largest in all of Jordan, with between 10,000 and 13,000 people attending daily prayers. It is also an important pilgrimage site, receiving 30,000 foreign visitors each year. It has an extensive garden, as well as tiled walkways and courtyards. Since the introduction of the greywater system in 2019, the mosque has logged a 75 percent reduction in the amount of freshwater it consumes.

The other mosques, though smaller, have also registered significant savings from their greywater systems. The Ministry of Awqaf, Islamic Affairs and Holy Places, which oversees the religious sites, has welcomed the approach as an important contribution to both cost savings and water stewardship.

* Greywater refers to domestic wastewater from sinks, showers, washing machines, dishwashers and any other sources which are not contaminated with human waste.



Promoting energy efficient & climate-friendly wastewater systems



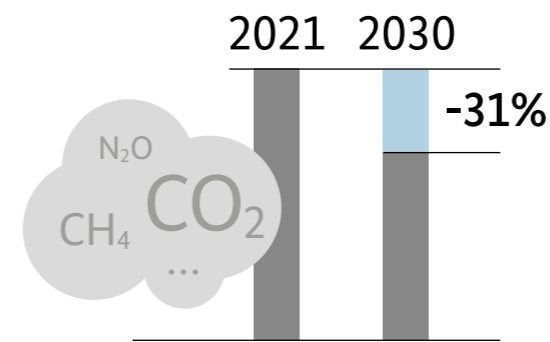
➤ The biogas digesters at the Wadi Shallalah wastewater treatment plant

Opportunities to reshape an energy-intensive sector

Wastewater collection and treatment systems are energy intensive – and have become more so over time. This is because the systems themselves have grown – in terms of new sewer connections and wastewater treatment plants – and because the treatment processes needed to produce effluent which meets the requirements of JS 893/2021 require more energy than earlier approaches did.³³ Aeration systems and dewatering centrifuges, for example, often run around the clock and consume huge amounts of electricity.

This puts Jordan in a bind: the very technologies which can help it to reduce the water deficit by generating reclaimed water lead to high electricity bills – and, when the electricity does not come from renewable sources, to climate-harming greenhouse gas emissions as well. Moreover, sludge, one of the main by-products of modern wastewater treatment, is itself a major emitter of methane, a potent greenhouse gas, when it accumulates in large quantities under anaerobic conditions.

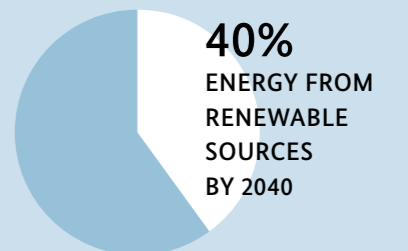
In its new National Water Strategy, the Government of Jordan aims to reduce the wastewater sector's energy and climate footprint by promoting greater energy efficiency, expanding the use of renewable energy and improving sludge management. It has set a target of producing 40 percent of the water sector's overall energy needs from renewable energy sources by 2040. In addition to its benefit for the climate, this could help to contain operating costs, as electricity is the largest cost driver for treatment systems. The strategy also calls for improvements in the management of sludge to protect the environment, maximise energy recovery and leverage opportunities for productive reuse. In all of these areas, the Jordanian authorities demonstrate an openness to innovation and new technologies which has long characterised its approach in the wastewater sector.



JORDAN'S COMMITMENT
REDUCTION IN GREENHOUSE GAS EMISSIONS BY 2030

CONTRIBUTIONS OF THE WATER SECTOR:

15%
LESS OVERALL ENERGY CONSUMPTION BY 2025



SOURCES: (1) Ministry of the Environment. (2021). Updated Submission of Jordan's 1st Nationally Determined Contribution (NDC). (2) and (3) Ministry of Water and Irrigation. (2023). National Water Strategy, 2023–2040. Energy Efficiency and Renewable Energy in the Water Sector. Objectives 1.3 and 2.2.



Better energy management practices

Germany supports its Jordanian partners to improve energy efficiency across its water sector operations. Technical cooperation projects implemented by GIZ support the establishment of an energy unit in the Water Authority of Jordan, as well as the implementation of an Energy Management System (EnMS) in the water utilities. This system offers a standardised way to plan, implement, monitor and adjust energy saving measures in different types of energy-using water and wastewater facilities, from pumping stations to wastewater treatment plants. The National Water Strategy 2023–2040 has set a target of implementing the Energy Management System in all energy-using water facilities by 2030.

ENERGY AUDITS UNCOVER VALUABLE SAVINGS

Detailed energy audits are part of this process. In recent years German development cooperation has supported energy audits at water pumping stations, which are the most energy intensive of all water facilities, as well as at a small number of wastewater treatment plants. Additional wastewater treatment plants will be audited in the coming years as the EnMS system is scaled up.

The audits review each step of the treatment cycle and identify opportunities for energy savings which are then passed on to the water utilities. The recommendations presented include both the anticipated energy savings (kilowatt hours/year) and the estimated investment needed to enact the change. Sometimes no or low-cost interventions can yield significant savings.

For example, in an energy audit carried out at the Madaba Wastewater Treatment Plant in 2020, a review of influent quality data showed that the plant could reduce its 'sludge age' – the average number of days that suspended solids need to remain in aeration tank to achieve desired effluent quality – from 25 to 15, thereby reducing the demand for oxygen by 20 percent.³⁴ This change, which would cost nothing to implement, could save the wastewater treatment plant over 48,000 JOD (61,000 EUR)³⁵ per year.

MAINSTREAMING ENERGY EFFICIENCY ACROSS COOPERATION MEASURES

In addition to periodic energy audits, German technical cooperation projects also work on a continuous basis with water utilities and the staff of wastewater treatment plants to optimise the plants' operational parameters to achieve high quality effluent with the lowest possible energy consumption. When parts need to be replaced or a new piece of equipment has to be procured, they advise on the most energy efficient options.

Energy efficiency is also reflected as one of six core areas in the Technical Sustainable Management approach (see p. 30). During inspection visits, wastewater treatment plant operators must show that they regularly document the energy consumption of all the main energy-intensive pieces of equipment in the plant, such as pumps and blowers, and compare 'before' and 'after' energy consumption rates following the implementation of any energy efficiency measure.

Physical measures implemented with financing through the KfW Development Bank are also required to promote energy efficiency. German-financed projects introduce technologies such as energy-optimised return pumps and aeration systems which use submersible infusers. Emissions are calculated before and after the implementation of each measure.

Harnessing the energy in wastewater to power operations

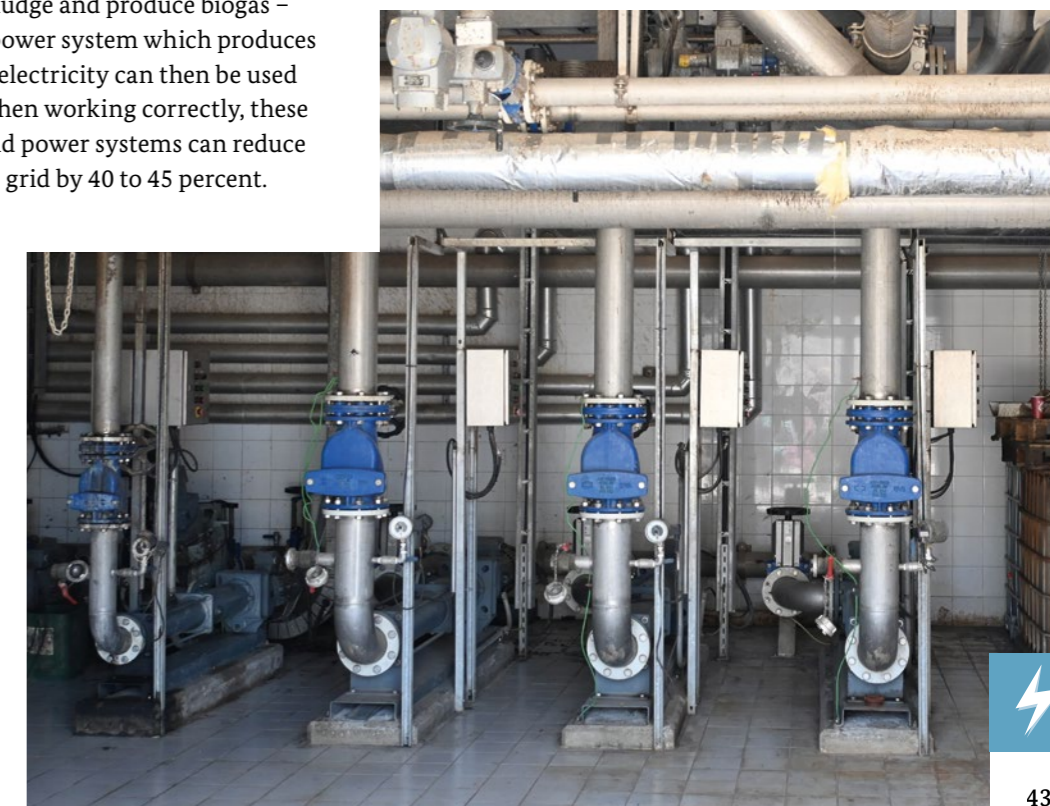
Wastewater treatment plants can help to reduce dependence on fossil fuels by producing and using renewable energy. With the right combination of technologies, treatment plants which operate at a certain scale can even achieve energy autarchy. The As Samra wastewater treatment plant, constructed with financial support from USAID and the Millennium Challenge Corporation, was the first in Jordan to demonstrate this potential. The combination of a biogas digester, a combined heat and power (CHP) system, hydraulic turbines on the influent and effluent pipelines, and photovoltaic cells means that As Samra requires little if any electricity from the grid to treat nearly 68 percent of all the wastewater generated in Jordan.³⁶

Germany is one of the partners helping to introduce elements of this successful model to other wastewater treatment plants which operate at a large enough scale to make energy recovery feasible. The KfW Development Bank has financed the construction of a biogas installation at the Wadi Shallalah wastewater treatment plant outside Irbid, and is currently constructing two more at Wadi Arab and Central Irbid and a fourth at As Salt in Balqa. Two more biogas digesters are planned for wastewater treatment plants in South Amman and West Jerash.

These systems link anaerobic digesters – large, closed tanks in which microorganisms break down the organic material in sludge and produce biogas – to a combined heat and power system which produces electricity and heat. The electricity can then be used to operate the facility. When working correctly, these biogas-combined heat and power systems can reduce energy demand from the grid by 40 to 45 percent.

As Samra has also shown how wastewater influent and effluent can be harnessed as a source of hydropower. KfW Development Bank is supporting the Water Authority of Jordan to construct two small hydropower plants on the pipeline which will carry effluent from the north of the country down to the Jordan Valley for irrigation (see p. 38). Using gravity to natural advantage, the plants will produce electricity from the effluent flows. The electricity will be fed into operations at the Wadi Arab and Central Irbid wastewater treatment plants, and to a pump station at a groundwater well.

→ The biogas production process at Wadi Shallalah wastewater treatment plant



Sustainable sludge management

The wastewater treatment technologies which are needed to produce effluent for reuse have a downside: they produce more sludge than natural treatment technologies, such as stabilisation ponds, do. As more and more wastewater treatment plants in Jordan adopt these active sludge technologies – and as the population grows, more households have sewer connections, and more wastewater is processed – the problem of how to manage and accommodate sludge is becoming more acute.

Traditionally sludge has been treated as waste. It has either been piled up on the outskirts of treatment plants or transported to landfills. These practices are, in fact, risky. When it rains, contaminants can leach into the soil and affect groundwater. When it accumulates in large piles, it contributes to anaerobic conditions and the production of powerful greenhouse gases such as nitrogen oxide and methane. Workers are not always aware of – or do not adhere to – safe handling practices, potentially putting their health at risk. There is also the ‘nuisance factor’: sludge generates unpleasant odours and can attract vectors such as flies, mosquitos and rodents.

The Government of Jordan acknowledges the safe and environmentally friendly management of sludge as a pressing challenge. But it also increasingly recognises that – with proper processing – sludge can be put to productive use. It is beginning to explore such possibilities, while paying close attention to both safety and social acceptability.

JORDAN'S FIRST MONO-LANDFILL FOR SLUDGE

Perhaps nowhere is the sludge management challenge more pressing than at the As Samra wastewater treatment plant. The private contractor which operates As Samra is required to treat sludge until it is 50 per cent dry, but is not responsible for its final disposal.

The solution the Water Authority of Jordan has chosen, and is implementing with support from Germany via KfW, is to create Jordan's first mono-landfill for sludge. The mono-landfill at As Samra will eventually have five waste cells – trenches in the ground lined with synthetic liners to prevent leachate from entering the soil and groundwater – which will be able to accommodate 2.8 million cubic meters of sludge. The first cell, which is already constructed, has capacity to receive sludge for four to five years. Once sufficient sludge is in place, the cell will be covered to allow gas to build up and be captured through a landfill gas management system. It will then either be burned off or used in the combined heat and power unit in the adjacent treatment plant. The mono-landfill offers an environmentally friendly solution for disposing of treated sludge which both protects groundwater and reduces emissions.

REDUCING SLUDGE VOLUMES IN ZA'ATARI CAMP

The wastewater treatment plant inside the Za'atari Refugee Camp produces approximately 65,000 cubic meters of sludge per year.³⁷ Until recently it has been transported in liquid form, in tanker trucks, to the Al Ekaider wastewater treatment plant, which treats domestic septage from communities without sewer connections. The frequent trips are not only costly and environmentally unfriendly, but also risk overloading the infrastructure at the Al Ekaider plant.

With funding from BMZ and the EU Regional Trust Fund in Response to the Syrian Crisis, German technical cooperation is introducing new sludge management practices at the camp. Using sludge thickening, dewatering and solar drying techniques, the GIZ-implemented project aims to reduce the volume of sludge by 90 percent. Smaller volumes of dried sludge mean fewer trips to Al Ekaider and will translate into cost savings of approximately 35 percent. It will also improve conditions within the camp and specifically in the area surrounding the wastewater treatment plant.

EXPLORING THE POTENTIALS OF SLUDGE AS A RESOURCE

German development cooperation is also supporting the Water Authority of Jordan to explore sustainable solutions for disposing of or reusing sludge from the country's other wastewater treatment plants. A feasibility study, financed by KfW Development Bank, is currently underway to identify options and make recommendations. At the same time, technical cooperation projects implemented by GIZ have been researching and testing out solutions for treating and reusing sludge, with the aim of unlocking its value as a resource. The results of these activities are being taken into consideration in the feasibility study.

One reuse potential is the application of dried biosolids to agricultural fields. In countries where this is practiced, it offers a natural way to enrich soils and can reduce the need for commercial fertilisers. It also has a positive climate impact, through the sequestration of carbon into the soil. In Jordan, German technical cooperation has supported multi-year research into the quality of biosolids and its effects on soil and vegetative cover. The results of these studies informed a decision by the Jordanian Ministry of Agriculture in late 2021 to lift the ban on the land application of biosolids. A technical working group including the Water Authority of Jordan, the National Agricultural Research Center and GIZ is currently considering a possible revision of standards on land application of biosolids in certain areas and in relation to specific categories of crops, such as fodder.

Another strategy is to transform sludge into products which can be used by industry. Sludge can, for example, be dried and compressed into pellets which are then burned in industrial kilns. It can also be transformed through pyrolysis – the thermal decomposition of organic material at high temperatures – into a powdery substance called biochar. Biochar can be used as a soil conditioner or fertilizer, or as an additive to paints, bricks or absorbent materials like insulation. With support from German technical cooperation, both pelleting and pyrolysis technologies are being tested out for the first time in Jordan.

It took time and sustained effort until farmers, consumers and other stakeholder groups in Jordan accepted the use of reclaimed water for irrigation. If biosolids are eventually to be reused under specific conditions this will require careful revisions to prevailing legal standards, as well as outreach and awareness campaigns to build people's trust. The Water Authority of Jordan is well aware of the need to ensure the social acceptability of this practice.



← Sludge management at the Mu'tah Mazar wastewater treatment plant



Strengthening governance and oversight



Water sector reforms: A work in progress

Achieving sustainable water security in Jordan will require more than infrastructure investments and more efficient service delivery. It will require financial reforms to put the water sector on sounder economic footing, including full cost recovery for operations and maintenance, and adjustments to water tariffs to protect the poor while phasing out the under-pricing of water for those who can pay. It also will also demand strong institutions with clear mandates and well-developed capacities to plan for and manage the country's limited water resources in the face of population growth and a changing climate. Good water sector governance is also important for accountability, and for building and retaining public trust in the government's ability to deliver essential services. The fundamental linkage between governance and water security is reflected in the overarching goals of the National Water Strategy 2023–2040, which prioritises reforms to the legal and institutional framework in the water sector (Pillar 1) and impartial and transparent regulation of water sector services and costs (Pillar 4).

Institutional restructuring in the water sector has been underway in Jordan for some two decades now. Important steps have been taken towards the separation of responsibility for bulk water supply and transmission, on the one hand, and the retail provision of water and wastewater services. In 2022, the Water Authority of Jordan completed the transfer of operational responsibility to the independent water utilities – a major milestone in the reform effort.

In line with the National Water Strategy 2023–2040, the Government of Jordan now seeks to accelerate the pace and extent of sector reforms. It strives to achieve clear organisational mandates for the different water institutions by resolving gaps and overlaps in functions and responsibilities which are still reflected in the complex web of laws, by-laws, policies and regulations. It seeks to enact legal and regulatory reforms so that the water utilities are able to function as independent commercial entities which can take autonomous management and operational decisions.

At the same time, the Strategy aims to consolidate responsibility for water resources planning, capital investment planning, outsourcing to the private sector, and monitoring and oversight within the Water Authority of Jordan. These shifts are to be accompanied by 2026 by the creation of an independent regulator which can promote transparency and accountability in the sector through impartial monitoring of the water utilities' performance, both financial and operational.



Germany's support for the reform agenda

Germany has supported water sector reform processes in Jordan since the 1990s, when technical cooperation projects began advising the Ministry of Water and Irrigation and the Water Authority of Jordan on a framework for decentralising and delegating operational roles to water utilities. It also worked closely with the governorate-level water administrations to improve their capacities in information management, financial management, customer management and operations management.³⁸ German development cooperation has continued working to strengthen institutional capacities at these two levels – national and utility – ever since. At present it works to strengthen planning, monitoring and coordination functions within the Ministry of Water and Irrigation, the Water Authority of Jordan and the Jordan Valley Authority. It also works directly with the water utilities to improve management and operational efficiencies in order to increase revenues and attain financial sustainability.

WATER AND WASTEWATER PLANNING

In the area of planning, German development cooperation supports the Ministry of Water and Irrigation with the development of the Third National Water Master Plan. This multi-volume resource draws together data and scenario planning to guide strategic investment decisions for the medium term, including for the wastewater sector. The part of the plan entitled 'Wastewater, Related Infrastructure, and Treated Wastewater Reuse' pays significant attention to the reuse of treated wastewater – an emphasis which is commensurate with the growing importance of reclaimed water to the country's water budget. GIZ is also working closely with the management of the Aqaba Water Company to prepare an infrastructure master plan for water and wastewater services in Karak, a governorate for which the company has recently assumed responsibility.



↓ Inspection of a wastewater treatment plant by the Utility Performance Monitoring Unit



TOWARDS INDEPENDENT REGULATION

German development cooperation also works to strengthen coordination, monitoring and oversight functions through the establishment and support for two units within the Water Authority of Jordan: the Project Management Unit (PMU), which oversees most large-scale infrastructure investments funded by development partners or private contractors, and the Utility Performance Monitoring Unit (UPMU), which is responsible for monitoring the performance of Jordanian water utilities.

The Utility Performance Monitoring Unit, established in 2018, reviews key performance indicators from the three water utilities and makes recommendations for improvements via annual monitoring reports. The data collection and reporting processes which the Unit is helping to establish could form the basis for a future independent regulator. Such an entity would be responsible for providing reliable and impartial analysis of utility services, financial performance and sector operating costs, free of any potential conflict of interest. This would represent an important step towards holding water sector institutions and water utilities accountable to the public.

↑ Utility Performance Monitoring Unit



03

A resilient future: Seizing opportunities, overcoming challenges



Effluent pond to store treated wastewater



← Operator at the Fuheis wastewater treatment plant

Jordan's wastewater journey continues

Jordan's bold wastewater journey is now in its seventh decade. One of the first countries to embrace the opportunities presented by reclaimed water, Jordan has succeeded in turning wastewater into a major asset in its quest for water security. Visionary thinking, careful planning, and strong partnerships have come together to shape a wastewater sector that has proven remarkably resilient in the face of shocks and challenges, from influxes of refugees to the COVID-19 pandemic. For Jordan's wastewater systems to remain resilient in the face of a hotter, drier future, however, the country must simultaneously build upon its achievements thus far and tackle certain systemic issues which threaten long-term sustainability. Some of the main opportunities and challenges are discussed below.

INVESTING IN WASTEWATER SYSTEMS

Jordan's current achievements in wastewater collection, treatment and reuse can be traced back to decisions taken long ago. Plans and designs which were decades in the making are now bearing fruit. They are the reason why Jordan has managed to navigate the past decade as well as it has.

Given the scale of the challenges ahead, it is more important than ever that Jordan and its international partners continue to 'think ahead' and 'think big' when it comes to investments in the wastewater sector. These investments need to be broadly conceived: infrastructure and physical assets are, on their own, not enough. Equally important are the systems, processes and human resources which are required to run them sustainably over time.

As a result of the institutional reforms already undertaken in the water sector, the three water utilities have the mandate to act as independent companies. It is important that their managerial and technical capacities continue to be strengthened, and that they are given the autonomy to perform their roles.

Notwithstanding this, the Ministry of Water and Irrigation and the Water Authority of Jordan may at times find it appropriate to outsource certain functions to private sector partners. Such partnerships are most successful when they are mutually beneficial, that is, when they provide financial returns as well as long-term value for the public in the form of resilient systems.

CHARTING A PATH TO FINANCIAL SUSTAINABILITY

Getting wastewater services onto sustainable financial footing is top priority for the coming years. Water utilities need to allocate more budget to the wastewater side of their operations. As long as the Operations and Maintenance of wastewater systems are chronically underfinanced, it is unlikely that the ambitious targets for reclaimed water which are spelled out in the National Water Strategy 2023-2040 can be met. Improving collection rates and reducing Non-Revenue Water is one important strategy to improve financial sustainability. Illegal connections must be targeted and sewer connection rates need to be increased.

In the longer term, however, regular adjustments to water tariffs will be required so that the price of water reflects its true cost. The National Water Strategy 2023-2040 and the Water Sector Financial Sustainability Roadmap, which was adopted in late 2022, commit to multi-year tariff increases as a key lever for achieving financial sustainability. It is critical that these provisions be implemented.

ADJUSTING INCENTIVES FOR ENERGY EFFICIENCY

While the opportunities are there to re-shape wastewater systems in a more sustainable direction, changes to the current policy framework could greatly accelerate this shift. At present the Water Authority of Jordan, as the owner of the water and wastewater infrastructure, pays the water utilities' electricity bills. Utilities therefore have little incentive to improve energy efficiency, as they do not benefit directly from cost savings. And at the national level, there are limits on the size of renewable energy projects which can be undertaken by water institutions, including at wastewater treatment plants. In practice this means that the water sector requires the cooperation and support of the Ministry of Energy and Mineral Resources in order to make sustained progress towards the government's renewable energy targets. Adjusting the incentive structure for energy efficiency and use of renewable energy both within the water sector itself, as well as between sectors, would improve the enabling environment for an energy transformation.

LEANING INTO THE CIRCULAR ECONOMY

Water scarcity has heightened receptiveness to circular economy principles in Jordan. The reuse of treated wastewater is firmly established. Greywater systems and rainwater harvesting are no longer novel, and everyday water-savings measures, such as low-flow faucets, are in wide use. The next frontier may be the reuse of biosolids. Explorations are still in the early stages and will require careful study and consideration. If the Water Authority of Jordan, in cooperation with partners and stakeholders, identifies safe and financially viable solutions for reusing biosolids, it will need to systematically build popular acceptance for these, just as it did for reclaimed water in the past. Transparent, accountable water sector institutions can help to strengthen public trust in novel approaches.

IMPROVING PERFORMANCE THROUGH INDEPENDENT OVERSIGHT

The institutional landscape in the Jordanian water sector has undergone profound changes over the past 15 years. The delegation of operational responsibilities to the three water utilities marks a major milestone in the reform process. A key priority for the coming years is the establishment of an independent regulatory body which can monitor water sector performance, ensure compliance, and act in the public interest. The creation of an independent regulator will help to build public trust in water sector institutions and will also contribute to an enabling institutional environment for new financial investments.

PARTNERING FOR SUSTAINABILITY

The water crisis is increasingly a global phenomenon. It cannot be managed by single nations. As Jordan moves into the next stage of its wastewater journey, it will continue to benefit from cooperation with many different types of partners. The challenges facing the country are formidable. Overcoming them will require a clear vision, sound planning, sufficient financial investment, openness to innovation and reform, and the willingness to share experiences and learn from others. Germany looks forward to continuing its fruitful cooperation with the Government of Jordan, whose commitment to fulfilling the human right to water and sanitation under extremely challenging conditions is both an inspiration and an example from which others can learn.

Annex

ANNEX 1:

Technical cooperation projects in the wastewater sector

Commissioned by: BMZ (if not stated otherwise)
Implementing organisation: GIZ

DECENTRALISED INTEGRATED SLUDGE MANAGEMENT (DISM) Duration: 2015–2019

The DISM project, which was implemented as part of the German Climate Technology Initiative (DKTI), demonstrated an integrated approach to the treatment and reuse of sludge. It explored the feasibility of the co-digestion of sludge with other biomass sources for potential application as fertiliser or soil conditioner.

DECENTRALISED WASTEWATER MANAGEMENT FOR ADAPTATION TO CLIMATE CHANGE IN JORDAN (ACC) Duration: 2014–2021

The ACC project supported partners in the introduction of decentralised wastewater management solutions as a climate change adaptation measure. It developed models for modular, decentralised wastewater treatment plants for domestic wastewater and sludge, tested methods for reusing treated wastewater, and developed tools for scaling up decentralised wastewater management.

ENERGY EFFICIENT WATER SECTOR (EEWS) Duration: 2021–2025

The EEWS project supports the institutionalisation of energy management in the Jordanian water sector in accordance with ISO 50001 and the Water-Energy-Food-Environment nexus. The main objective is to enhance cost recovery in the water sector by increasing its operational efficiency and improving the coordination of resources planning.

IMPROVEMENT OF COMMUNAL WATER EFFICIENCY THROUGH COOPERATION WITH RELIGIOUS AUTHORITIES (WI) Duration: 2015–2023

The WI project strengthened water awareness and water saving behaviours in cooperation with Jordanian religious authorities. Measures included the development of a teaching unit for religious instruction in secondary schools, the dissemination of messages about water savings through Friday sermons, and the introduction of water-saving measures in mosques.

IMPROVEMENT OF ENERGY EFFICIENCY IN THE WATER SECTOR (IEE) Duration: 2017–2021

The IEE project aimed to strengthen awareness of energy efficiency in the water sector and to enable sound decision-making which takes energy efficiency into account. Its primary approach was to support the adoption of a systematic energy management system within water sector institutions.

MANAGEMENT OF WATER RESOURCES II (MWR) Duration: 2019–2022

The MWR project assists Jordan's water sector institutions to determine the optimal use of water resources and to strengthen water sector governance. It does this by supporting planning for water resource allocation and infrastructure investments; the efficient management of retail irrigation water; independent regulation of the water sector; and leadership and management capacity.

SANITATION FOR MILLIONS (S4M) Duration: 2017–2022 / Commissioned by: BMZ, with co-financing from the Bill and Melinda Gates Foundation

S4M is a global project with activities in 15 countries. In Jordan, the project worked in cooperation with the Ministry of Awqaf, Islamic Affairs and Holy Places, as well as the Ministry of Water and Irrigation, to improve access to sanitation in Amman, Irbid and Mafraq. It supported the construction and rehabilitation of sanitation facilities at mosques; introduced the Hausmeister concept to improve maintenance; installed on-site greywater systems at mosques; and raised awareness about sanitation and hygiene in cooperation with religious actors.

STRENGTHENING CAPACITIES FOR WASTEWATER MANAGEMENT (CWWM) Duration: 2017–2021

The CWWM project worked in cooperation with the Water Authority of Jordan to strengthen individual and institutional capacities in wastewater management, particularly in wastewater treatment plants operated by Yarmouk Water Company. The management system 'Technical Sustainable Management' was introduced to Jordan under the auspices of this project.

STRENGTHENING THE RESILIENCE OF WATER UTILITIES II (RWU II) Duration: 2018–2023

The RWU II project worked to reduce Non-Revenue Water and improve cost recovery in selected regional operating units of the Yarmouk Water Company and Balqa Water Administration. It focused on process optimisation, digitalisation of commercial management and organisational development.

SUSTAINABLE SLUDGE MANAGEMENT (SSM) Duration: 2020–2024

The SSM project aims to improve the economic and ecological sustainability of sludge management by exploring the feasibility of technology-based upcycling solutions, such as pyrolysis and pelleting, which would allow treated sludge to be used as an energy carrier, an industrial raw material, or a compost additive. The project also explores the marketability of sludge-based products.

VOCATIONAL EDUCATION AND TRAINING FOR JORDANIANS AND SYRIAN REFUGEES IN THE WATER SECTOR (VTW) Duration: 2017–2021

The VTW project addressed the lack of skilled professionals in the water sector through the implementation of training courses for female and male skilled and semi-skilled sanitation professionals – both Jordanian and Syrian – and by helping them to organise into cooperatives. It also worked with the Water Authority of Jordan to develop a comprehensive approach to human resource development and supported the rehabilitation and organisational development of the Water Training Center.

WASTEWATER TREATMENT, REUSE AND WATER SUPPLY (WTR) Duration: 2020–2025 / Commissioned by: BMZ, with co-financing from the European Union

The WTR project aims to improve the performance of water sector institutions in Jordan. In the area of wastewater, it works to strengthen the oversight function of the Water Authority of Jordan and to improve wastewater management countrywide through the integration of Technical Sustainable Management. It focuses in particular on strengthening the organisational and technical capacities of wastewater staff at Yarmouk Water Company through human resource development measures and the introduction of standard operating procedures.

WASTE TO POSITIVE ENERGY Duration: 2016–2023 / Commissioned by: BMZ, with co-financing from the European Union

This project, which is part of the BMZ Special Initiative 'Tackling the root causes of displacement', aims to improve the living conditions of residents in the Za'atari and Azraq refugee camps through more efficient waste management and employment opportunities in the waste sector. One component of the project focus on the environmentally friendly and cost-efficient disposal of sludge.

WATER SECTOR GOVERNANCE (WSG) Duration: 2023–2026

The WSG project strengthens water sector governance in Jordan by promoting information sharing and dialogue among public and water sector institutions; supporting the development of an independent regulator for the water sector; improving human resources management; establishing new operational structures and digital tools for bulk water planning and allocation; and protecting and expanding digital information systems.

ANNEX 2:

Financial cooperation projects in the wastewater sector

Commissioned by: BMZ

Implementing organisation: KfW

CLIMATE-ADAPTED INFRASTRUCTURE PLANNING IN THE WATER SECTOR

Duration: 2021–present

Building on the results of ongoing projects for the preparation of a national water master plan, a detailed wastewater treatment concept for the cities of Amman and Zarqa is to be prepared within the framework of this grant-financed module. The aim of the module is to contribute to improving the allocation of the investment budget in the sector and thereby to the sustainable and efficient management of scarce water resources in Jordan.

CLIMATE PROTECTION IN THE WASTEWATER SECTOR

Duration: 2013–present

A loan from KfW made possible the construction of a mono-landfill at the As Samra wastewater treatment plant, as well as upgrades to the Wadi Arab and Central Irbid wastewater treatment plants, including the installation of biogas digesters. An accompanying grant has provided support to the Yarmouk Water Company for operation of Wadi Arab, Central Irbid and Wadi Shallalah wastewater treatment plants, including the procurement of spare parts.

IMPROVING ENERGY EFFICIENCY THROUGH ELECTRICITY GENERATION FROM BIOGAS IN WASTEWATER TREATMENT PLANTS

Duration: 2022–present

With a loan from KfW, the Water Authority of Jordan is upgrading two wastewater treatment plants in South Amman and West Jerash. This includes the installation of biogas digesters.

RESULTS-BASED PROGRAMME WATER SECTOR

Duration: 2021–present

This grant to the Water Authority of Jordan has allowed for the provision of performance-based financing to the three water utilities for maintaining operations during and after the COVID-19 pandemic. A second phase supports performance-based investment measures for improving Operations & Maintenance of existing facilities.

SANITATION PROGRAMME: NEXUS AND RESOURCE PROTECTION

Duration: 2016–present

This flexible loan-based funding programme comprises multiple measures, including the construction of sewer networks in Shafa Badran, Al Mansour and Um Halilifa; the energy efficient rehabilitation and extension of the As Salt wastewater treatment plant; and the construction of a hydroelectric plant as part of the reuse system in the northern Jordan Valley.

SUPPORT OF WATER SECTOR REFORMS (DPL II)

Duration: 2019–2023

This policy-based loan aims to improve financial sustainability in the water sector, improve Operations & Maintenance, reduce Non-Revenue Water and improve water resources management. An additional accompanying measure provided technical support to the PMU and UPMU.

WASTEWATER KARAK AND KOFRANJAH

Duration: 2004–present

This loan targets sewer network extensions and the construction/rehabilitation of new wastewater treatment plants in Karak and Kofranjah. An accompanying grant will provide support for the operation of the Karak wastewater treatment plant.

WATER RESOURCES MANAGEMENT PROGRAMME (II–VII)

Duration: 2012–present

This flexible loan-based funding programme comprises multiple measures, including the introduction of a treated wastewater reuse system in the northern governorates and the construction of a hydropower plant; the construction of the West Zarqa Force Main; the expansion of the mono-landfill at As Samra; upgrades and/or expansions of wastewater treatment plants, including the installation of biogas digesters; and expansions of sewer networks.

WATER SUPPLY AND SANITATION FOR SYRIAN REFUGEES AND HOST COMMUNITIES (V–X)

Duration: 2017–present

These grant-based investments aim to expand and improve the performance of water networks; to connect underserved areas of Greater Irbid to sewerage networks; to strengthen the capacity of staff at Yarmouk Water Company; and to improve access to water for people in vulnerable communities, including Syrian refugees.

Materials referred to in this publication are available on the SuSanA platform, a key knowledge base for the sector: www.susana.org

sustainable sanitation alliance



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As at

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