Ex post evaluation – Jordan

Sector: Sanitation and waste water management - large systems (CRS code 14022)
Project: Waste water disposal Greater Irbid II (1998 65 726)*
Implementing agency: Water Authority of Jordan

Ex post evaluation report: 2017

		(Planned)	(Actual)
Investment costs (total)	EUR million	96.9	98.0
Counterpart contribution	EUR million	33.9	35.0
Financing	EUR million	63.0	63.0
of which BMZ budget funds	EUR million	63.0	63.0

*) Random sample 2016

Summary: The project covered the construction of the Wadi Shallalah treatment plant, including sewerage networks for 8 smaller localities to the east of the city of Irbid and supply lines to the treatment plant. Jordan's first ever sludge digestion system (digesters) was built on the treatment plant's premises. With the help of gas generators, the sewage gas generated in the digesters is used for energy to reduce the energy costs for treating waste water. The treatment plant was designed to make the treated waste water usable for irrigation in the Jordan Valley.

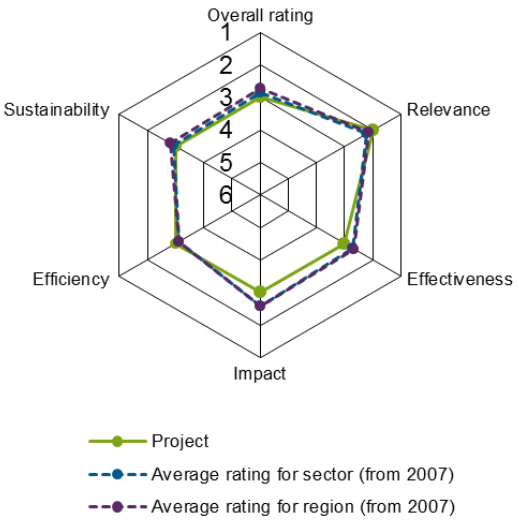
Development objectives: The goal of the project was to guarantee safe and hygienic sanitation in the project area (module objective). This outcome aimed to contribute to reducing health risks for the people living in the project area. Moreover, the measure aimed to protect scarce water resources, particularly by preventing any further increases to nitrate levels in the project area's groundwater over the long term and by using purified waste water for agricultural irrigation (programme objective).

Target group: The target group was the population living in the catchment area for the Wadi Shallalah treatment plant. At the time of the project appraisal, this group amounted to around 100,000 to 120,000 residents. Furthermore, farmers in the Jordan Valley who could benefit from the use of treated waste water were also among the potential beneficiaries of the project.

Overall rating: 3

Rationale: At the moment, the plans to use treated waste water for agricultural irrigation cannot be realised, as the waste water is mixed with water from two other treatment plants and these currently fail to meet the requisite parameters. Nevertheless, the project is helping to protect groundwater through the effective purification of waste water. In light of the region's population growth, groundwater protection is now growing in importance.

Highlights: The plants were constructed during a difficult period for Jordan, marked by two major waves of refugees from Iraq and Syria. The operator was and still is faced with huge challenges when it comes to securing the water supply and waste water disposal. The intended takeover of the treatment plant by a private operator was unsuccessful, which led to further accompanying measures aiming at improving the qualification of the public disposal company.



Rating according to DAC criteria

Overall rating: 3

Ratings:

Relevance	2
Effectiveness	3
Efficiency	3
Impact	3
Sustainability	3

Relevance

A core problem for water resource management in Jordan is low availability of water. With renewable water resources of 160 m³ per resident per year, Jordan was already one of the world's most arid countries at the time of the project appraisal. The Jordanian government's strategy therefore aims to use the scarce water resources multiple times. One key prerequisite for this is the treatment of sewage water. Since the project appraisal, the Jordanian water strategy was revised several times, though the treatment and reuse of sewage water in agriculture always remained an exceptionally important factor. The project was and continues to be highly relevant for Jordan. Two waves of refugees, from Iraq in 2003 and Syria in 2011, have contributed to a high level of population growth. Since the project appraisal took place, the population in the city of Irbid has more than doubled from an estimated 200,000 (1999) to an estimated 500,000 (2015) while water availability has remained consistently low. Some of the 8 localities close to Irbid selected for the project have also undergone significant growth. Water availability has therefore significantly dropped since the project appraisal (to 60 m³/resident in 2014). The urgent need for and importance of the efficient use of water has therefore increased significantly over recent years.

The German development cooperation in the sector is part of an integrated water resource management (IWRM) approach, which was agreed by the German and Jordanian governments in a joint sectoral strategy paper. Other donors in the sector include EU, USAID, AFD (France) and JICA (Japan).

In principle, the selected approach of collecting sewage water in sewer networks, treating it and then supplying it for agricultural use is very well suited to making efficient use of limited water resources and at the same time providing safe and hygienic waste water disposal. Furthermore, an improved use of scarce water resources can also reduce the potential for conflict over resource utilisation.

Relevance rating: 2

Effectiveness

The project aimed to collect the waste water generated in the project area, subject it to a suitable purification process and supply it for reuse in agriculture. The defined module objective was to ensure safe and hygienic waste water disposal in the project area. The indicators were defined as the rate of connection to the treatment plant and the discharge parameters. The connection rate to the sewerage system is designed to provide information regarding the collection of waste water in the catchment area, while the discharge parameters are intended to document the purification capacity of the treatment plant. The indicators defined during the project appraisal are deemed appropriate from today's perspective.

At the time of evaluation, the connection rate in the project area was around 72%. During the project appraisal, it was assumed that 7,400 m³ of incoming wastewater would have to be treated per day if the connection rate were 70%. This value has more or less been realised now, with an average flow rate of 7,000 m³ per day. This will even be exceeded in the near future, as another larger locality (Al Husn) has been connected to the treatment plant since March 2017. The current flow rate to the treatment plant can mainly be explained by the fact that a large number of buildings have been built recently and connected to

the existing sewerage system. There is still unsatisfied demand for connections to the wastewater network for existing buildings.

For the assessment of discharge values, data from 2015 and 2016 were evaluated to begin with. Although some samples were within the permitted thresholds, the majority of samples exceeded the limits. The average values for 2015/2016 are 53 mg/l for BOD5, 63 mg/l for TSS (total suspended solids) and 108 mg/l for T-N (total nitrogen), which represents a 76 to 116% transgression from the target values. All samples complied with the set limits for NO_3-N (nitrate nitrogen). In the case of T-N (total nitrogen), however, the values were significantly higher than the maximum limits. The unsatisfactory discharge values for the years 2015 and 2016 can be traced back to the fact that the sludge could not be removed from the treatment plant as the Akader sludge disposal plant was closed temporarily. Discharge values later submitted by the treatment plant's in-house laboratory for the period between February 2017 and May 2017 show compliance with the limits at present. However, the monitoring figures for the discharge parameters collected by the central laboratory at Yarmouk Water Corporation (YWC) for the same period were slightly higher, and in turn slightly higher than the permitted thresholds. It is likely that these deviations are the result of measurement errors. In general, however, the purification capacity achieved can be rated as positive, since the ambitious targets are met or almost met for each measurement. Nevertheless, the purification potential of the treatment plant has not yet been realised to the fullest. In theory, the plant's technical design is suited to achieving the discharge values originally anticipated (relating to BOD5, TSS, and T-N). However, far too few samples are taken overall to manage the system in the ideal way. The number of coliform bacteria in the treated waste water was above 160,000/100 ml in all samples and therefore outside of the measuring range. This can be explained by the fact that the disinfection system was not launched until November 2016. However, all samples taken – even after the disinfection system was put into operation – also exceeded the threshold of 1,000/100 ml. The disinfection system therefore was not working effectively at the time of evaluation, though this was also linked to the suboptimal purification capacity of the treatment plant at the time of evaluation. The turbidity values recorded at the drains for the secondary clarifiers were too high for the disinfection plant (between 10 and 200 NTUs/nephelometric turbidity units). Plans are in place to mix the treated waste water with waste water from the treatment plants in Wadi al Arab and Central Irbid. This water will then be supplied for use in agricultural irrigation. However, as these two treatment plants have yet to reach the required purification capacity, this plan cannot be implemented at the moment. To cut energy costs, the disinfection system is not running at the moment.

On this point, it is important to note that the construction of the disinfection plant was separated from the rest of the project for cost reasons and funded by another FC measure (water resource management programme II, BMZ 2010 66 935). However, as this system is related to the context of the project and is an integral part of the treatment plant, it has been incorporated into the evaluation.

Two years after the final inspection (December 2014) not all of the plant had been handed over to the operator, which has impaired operations. Planning errors were detected during the evaluation. For instance, the disinfection system floods when the pumps fail, while the faecal sludge deposit in Wadi Shallalah created as part of the project is not compatible with Jordanian sludge vacuum trucks, which have to tip their contents. As sludge cannot be tipped into this system, these components were not put into operation, meaning that the faecal sludge collected from cesspits needs to be disposed of by other, presumably less environmentally friendly, means. Conversion work is required to ensure the anticipated functionality of all plant components and to protect the electrical components from flooding. The circulation pumps designed for the sludge digesters were too small. As a result, the digester could not be heated properly, initially impeding power and gas production. The pump was replaced after the evaluation was completed and gas production has now reached the levels anticipated.

The attainment of the project indicators defined during the programme appraisal can be summarised as follows:

Indicator	PA Status, PA target value	Ex post evaluation
(1) Connection rate to the Wadi Shallalah treatment plant	Status PA: 0% Target value PA: >70%	Approx. 72%
(2) Discharge values for treatment plant	Status PA: No purification PA target value: BOD5 <30 mg/l TSS <30 mg/l NO_3-N <25 mg/l T-N < 50 mg/l Coliforms < 1000/100 ml Nematodes < 1/1000 ml	The purification capacity is rated as positive. The target values have been fully or almost fully achieved since 2017 (depending on the measurement). The limit values for coliforms exceed the thresholds because the waste water currently cannot be used for irrigation and no disinfection occurs as a result.
(3) Capacity level of the treatment plant	PA target value: 7,400 m³/day	7,000 m³/day

The hydraulic capacity level of the treatment plant was around 50% at the time of the ex post evaluation. During the project appraisal, the plant was expected to treat a total of 7,400 m³ of waste water per day four years after completion of the plant. During the final inspection, this value was 4,000 m³ per day and has now reached 7,000 m³ per day, which is close to the target value. The capacity utilization level is therefore considered satisfactory.

Effectiveness rating: 3

Efficiency

Out of the total costs of around EUR 98 million, around EUR 55 million were assigned to the construction of the Wadi Shallalah treatment plant. The plant is designed for a population equivalent (PE) of 170,000. This results in costs of EUR 323 per resident. This relatively high figure can be explained by the complex plant technology used. The technology includes the treatment and pump systems required to recycle the waste water and the newly constructed sludge digestion system. However, the sludge digestion system reduces the treatment plant's operating costs, as less oxygen needs to be artificially added to the treatment process and the sewage gas generated can be made available for energy recovery. The total costs therefore appear to be suitable. For each population equivalent, an extra sum of around EUR 215 is added as a capital expenditure on the sewerage network. When compared on an international scale, this value also seems to be suitable.

Currently, around 80,000 PEs are connected to the treatment plant. The target group is reluctant to connect to the sewerage system, since this results in costs for waste water fees and there is no requirement to connect to the system (or no such requirement has been implemented). Waste water fees rise in a graduated manner with consumption. There is no base rate. Applying the model monthly consumption of 18 m³ of drinking water, the waste water fee of EUR 0.17 per m³ is exceptionally low and is around 30% of the total water tariffs. Nevertheless, slow demand for connection to the sewerage system despite the low fees should not be seen as an indicator of poor allocation efficiency. As the sewage treatment counteracts strain on the very scarce water resources, the allocation efficiency level clearly appears to be sufficient.

The low tariff revenues are unable to cover the operating costs. During the project appraisal, the operating costs were estimated to be EUR 0.29 per cubic metre based on the plants working at full capacity and taking into account subsidised energy prices. Cross-subsidisation beyond the water price is required at this time. Operation of the plant therefore exacerbates the already difficult situation at Yarmouk Water Corporation. As a result of further investments in the waste water network, higher quantities of waste water will

be supplied to the treatment plant over the medium term, which will increase the plant's capacity utilization on the one hand but will also further increase operating costs and shortfalls at YWC on the other.

Efficiency rating: 3

Impact

The programme objective was defined as "contributing to the reduction of health risks to the population living in the project area and contributing to the protection of limited water resources". No indicators were defined for this.

In light of the high population density and the karstic aquifers present in some areas, the existing septic tanks pose health and hygiene risks. Groundwater, which is also extracted for the drinking water supply, can be contaminated by pathogens and have high levels of nitrates. For the assessment of the nitrate content in the groundwater, the project executing agency provided nitrate values in 2009 and 2015 for a drinking water well in the project region. At around 30 mg/l, the nitrate content of the groundwater is stable and below the level of 50 mg/l permitted for the drinking water supply. The treatment plant was therefore built in time before nitrate could pose a risk to the water supply. The proportion of households connected to the treatment plant will also continue to rise in future. Over the long term, the risk of grey water contaminating the groundwater will drop and the project will make a significant contribution to the protection of limited water resources in the project area, although groundwater resources may still be at risk from other contaminants from agriculture.

The utilisation concept for the use of treated waste water plans to mix the waste water from three treatment plants. After this, it is to be fed into the Jordan Valley to be mixed with the King Abdullah Canal's irrigation water. As the Central Irbid treatment plant has not yet been rehabilitated and the disinfection unit at the Wadi al Arab treatment plant has yet to be put into operation, use of waste water is currently not permitted in accordance with Jordanian standards. Therefore, this component was yet unable to lessen the strain on the scarce water resources.

One important positive yet unintended impact is the provision of sanitation solutions related to the high, unexpected migration to the project area. The sewerage lines built in the project area now enable new buildings to be directly connected to the waste water system so that their waste water can be treated.

Impact rating: 3

Sustainability

To limit sustainability risks for the project, two important implementation agreements were concluded. Firstly, it was agreed that measures would be adopted to raise YWC's operating cost coverage rate from 2001 to at least 125%. Furthermore, it was agreed that a private operator would be brought in to operate the Wadi Shallalah treatment plant. The goals of both agreements ultimately could not be achieved. Over the past 14 years, the coverage rate for operating costs was 75% on average. YWC, the operator of the treatment plant, has high levels of debt; its payment obligations are around EUR 95 million, the majority of which stem from outstanding accounts to the state energy supplier. There is practically no maintenance budget available for operating the treatment plant. At the moment, the operation is supported by GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) due to a lack of FC funds available for this. GIZ ensures that financial and organisational measures needed to procure spare parts for YWC are made available.

As the planned improvements to the organisation at YWC by a private management operator were terminated, it was agreed that the treatment plant's manufacturer would be commissioned to operate the treatment plant in the interim. Job roles were filled twice, once with staff from the private operator and once with YWC employees to ensure a transfer of knowledge during operations. This model proved to be less than successful and the anticipated knowledge transfer did not take place. The operating contracts were not extended for this reason. No operating manuals for the systems were available when GIZ began providing support.

At the time of evaluation, the majority of the plant components were in a decent condition. When the plant components were constructed, unsuitable materials were used in some cases, which failed to meet the

strict corrosion protection requirements in place for the treatment plant. In the medium-term future, these parts are therefore likely to need replacing, though YWC will find it difficult to cover the relevant costs. This is also true of safety-related equipment such as in the digesters and ventilation systems in the sludge dehydration facilities.

The German development cooperation has responded to these challenges in a number of ways. In June 2016, the Technical Cooperation deployed an experienced treatment plant manager to the plant, who is now helping to establish the necessary maintenance and operating processes. The first successful outcome of this measure has already become evident; discharge values for the treatment plant are now within the specified target range, though they have yet to fully reach the required targets. This provision of practical local support by experienced treatment plant staff is now being continued by the Financial Cooperation in the form of an agreed accompanying measure related to climate protection in the waste water sector which will run until 2023 (BMZ 2016 70 249). The accompanying measure will also provide sufficient funds to cover the replacement parts needed for operations. Under a new measure in the Technical Cooperation, the operator YWC is also receiving support in standardising operating processes and certifying operations at all of its treatment plants. Knowledge is expected to be transferred to the operator, helping to improve treatment plant operations as a result. The sustainability in terms of operational expertise is therefore likely to increase.

Funding for ongoing operations is not guaranteed and therefore continues to pose a high risk to sustainability. YWC is currently supported by GIZ and other donors, aiming to improve its financial performance capacity. The Jordanian government has also accepted the International Monetary Fund's conditions for the gradual increase of drinking water and waste water tariffs.

Despite these endeavours, the programme's financial sustainability is still impeded by a number of other factors. The subsidies paid so far for energy costs are set to decrease further. As energy costs make up a large share of YWC's operating costs, this development will place further strain on the level of coverage for operating costs. As public sector salaries are very low in Jordan, qualified staff are migrating to other Gulf nations or crossing to the private sector. Tariffs would have to increase further to allow the government to pay competitive wages. Furthermore, the planned measures will not provide a speedy solution to the executing agency's debt problems. Successful operation of the treatment plant currently depends on external financial support. While dependency is predicted to drop over the coming years, it will not be eliminated completely.

From today's perspective, the measure's sustainability is rated as just about satisfactory, despite the significant risks particularly relating to the financial security of operations.

Sustainability rating: 3

Notes on the methods used to evaluate project success (project rating)

Projects (and programmes) are evaluated on a six-point scale, the criteria being **relevance**, **effectiveness**, **efficiency** and **impact**. The ratings are also used to arrive at a **final assessment** of a project's developmental efficacy. The scale is as follows:

Level 1	Very good result that clearly exceeds expectations
Level 2	Good result, fully in line with expectations and without any significant shortcomings
Level 3	Satisfactory result – project falls short of expectations but the positive results dominate
Level 4	Unsatisfactory result – significantly below expectations, with negative results dominating despite discernible positive results
Level 5	Clearly inadequate result – despite some positive partial results, the negative results clearly dominate
Level 6	The project has no impact or the situation has actually deteriorated

Rating levels 1-3 denote a positive assessment or successful project while rating levels 4-6 denote a negative assessment.

Sustainability is evaluated according to the following four-point scale:

Sustainability level 1 (very good sustainability): The developmental efficacy of the project (positive to date) is very likely to continue undiminished or even increase.

Sustainability level 2 (good sustainability): The development effectiveness of the project (positive to date) is very likely to decline only minimally but remain positive overall (this is what can normally be expected).

Sustainability level 3 (satisfactory sustainability): The developmental efficacy of the project (positive to date) is very likely to decline significantly but remain more or less positive overall. This rating is also assigned if the sustainability of a project is considered inadequate up to the time of the ex post evaluation but is very likely to evolve positively so that the project will ultimately achieve positive developmental efficacy.

Sustainability level 4 (inadequate sustainability): The developmental efficacy of the project is inadequate up to the time of the ex post evaluation and is very unlikely to improve. This rating is also assigned if the sustainability that has been positively evaluated to date is very likely to deteriorate severely and no longer meet the level 3 criteria.

The **overall rating** on the six-point scale is compiled from a weighting of all five individual criteria as appropriate to the project in question. Rating levels 1-3 of the overall rating denote a "successful" project while rating levels 4-6 denote an "unsuccessful" project. It should be noted that a project can generally be considered developmentally "successful" only if the achievement of the project objective ("effectiveness"), the impact on the development objective ("impact") **and** the sustainability are rated at least "satisfactory" (level 3).