KfW Development Bank

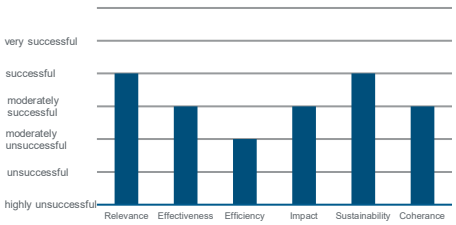
Ex post evaluation
Refurbishment of pump stations I & II, Egypt

Title	Refurbishment of pump stations I, refurbishment of pump stations II, basic and advanced training measure		
Sector and CRS code	Agriculture (CRS code: 31140)		
Project number	BMZ-No. 1998 66 583, 2001 65 902, 1930 02 581		
Commissioned by	Complementary measure for economic cooperation and development (Federal Ministry for Economic Cooperation and Development)		
Recipient/Project-executing agency	Mechanical and Electrical Department (MED) of the Ministry of Water Resources and Irrigation (MWRI)		
Project volume/ financing instrument	EUR 135.55 million, of which EUR 22.96 million (Phase I) and EUR 1.36 million (Phase 2) in budget grants/loans, EUR 14.47 million in composite financing (Phase 2), EUR 96.76 million in counterpart contributions		
Project duration	Phase 1: 1998 – 2018, phase 2: 2002 – 2018		
Year of report	2021	**Year of random sample**	2021

Objectives and project outline

The two project phases involved investments in the refurbishment of outdated irrigation and dewatering pump stations. The project's outcome-level objective was to ensure affordable irrigation and dewatering of the farmland in the stations' areas. At impact level, the goal was to help protect and increase agricultural revenue and income for roughly 216,000 family businesses, mostly smallholdings, in the catchment area. A total of 14 pump stations were refurbished, and in phase II, basic and advanced training measures were conducted in the areas of planning, management, operation, and maintenance.

Overall rating:
moderately successful



Key findings

– It can be assumed that refurbished dewatering stations make an impact: for all of the stations visited, it was confirmed that water-logging and soil salinity were reduced through the lowering of the water table and agricultural revenue could be increased. In the case of the dewatering station visited, the investment did not have a positive impact because the volume of water remained insufficient. Since far fewer pump stations were refurbished than originally planned (14 instead of 21), the effectiveness and overarching developmental impacts are rated as satisfactory.

– The project's efficiency suffered primarily due to extensive delays in the cooperation with the partner. This resulted in price increases, which led to added costs of 70% combined with a lower number of stations refurbished. Given the water availability, the installed pump capacities are generally regarded as over-dimensioned in technical terms.

– The impacts' sustainability is particularly at risk from the decreasing water availability caused by climate change and distribution conflicts. Lower volumes of water call for alternative irrigation techniques, and the refurbished pump stations are not designed for these. Given the current speed of the reforms to the irrigation system, the pump stations are likely to just about reach their technical useful life before becoming obsolete. Other risks include defective operation and inadequate maintenance. However, there was no indication of these issues in the ex post evaluation.

Conclusions

– The impact-oriented management and measurement of target achievement was made significantly more difficult by qualitative defects in the target system.

– Long delays created high losses in economic efficiency. The retrospective deployment of an implementation consultant just about facilitated a lower level of target achievement.

– The promotion of close cooperation with TC projects, integrated irrigation management and capacity-building in the MED should be the goal.

– In future, the promotion of more efficient irrigation methods (e.g. sprinklers) must play a greater role.

1 = very successful, 2 = successful, 3 = moderately successful, 4 = moderately unsuccessful, 5 = unsuccessful, 6 = highly unsuccessful

Rating according to DAC criteria

Overall rating: 3

This EPE is a joint assessment of the two related project phases “Refurbishment of pump stations I” and “Refurbishment of pump stations II”, whose time frames overlapped with one another. The evaluation of the two phases is conceptually identical since both phases pursue very similar theory of change and target indicators and are largely made up of identical measures.

Ratings:

Relevance	2
Coherence	3
Effectiveness	3
Efficiency	4
Impact	3
Sustainability	2

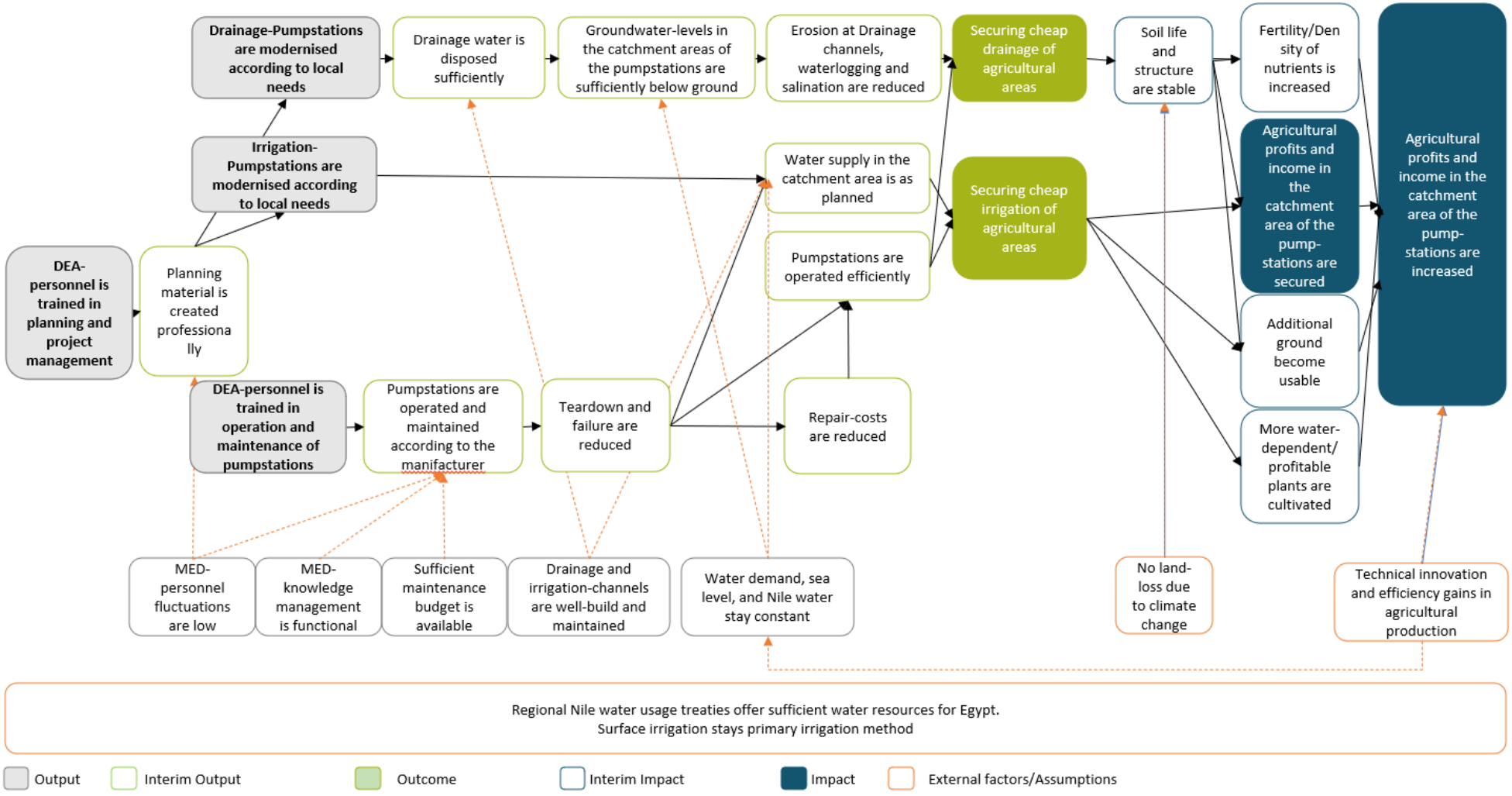
Relevance

From both the perspective at the time, and today, the disrepair of pump stations is demonstrably one of the core problems in the Egyptian irrigation system and agricultural production. The Egyptian agricultural sector supplies a rapidly growing population from just a small area suitable for farming purposes and is almost completely dependent on irrigation. Due to the geographical circumstances (low ground above sea level) and the prevailing irrigation methods (surface irrigation), pump stations are essential for agricultural production. Dewatering via drainage pump stations prevents the water table and soil salinity from rising, which otherwise can lead to high crop losses. In addition, irrigation by irrigation pump station secures crop yields and enables more profitable plants to be cultivated. Effective dewatering and irrigation benefit low-income smallholders in rural areas in particular. Figure 1 shows a detailed, revised impact model for the project, including the external influencing factors relevant for the project.

The pump stations used in Egypt tend to have a technical service life of 20 years. A great deal of the Egyptian irrigation and dewatering system was established in the first half of the 20th century, which is why many of the 1,500+ pump stations had drastically exceeded their service life at the start of the project in 1998, which in turn led to effectiveness losses and inadequate irrigation and dewatering. Due to inadequate dewatering, 25% of farmland was affected by increased salinity (FAO 2016). One of the Egyptian government’s focal points was therefore set on improving field drainage. At the start of the project, around 500 pump stations were assessed as needing refurbishment. Between 1983 and 2000, the World Bank restored around 170 pump stations. The project therefore fitted in well with existing national and international policies in the sector.

Phases I and II of this project refurbished 14 pump stations (though the original plan was 21 stations) within Egypt’s highly complex irrigation and dewatering system. At the time of the project appraisal, there were no realistic alternatives to this approach that would have met the need for proper irrigation and dewatering at short notice. However, from today’s perspective, it can be argued that the Egyptian irrigation system – within which the pump stations are essential for irrigation and dewatering – is only effective when large volumes of water are available, which cannot be guaranteed over the long term. Alternative methods that work with lower volumes of water and use fewer resources (e.g., electricity) require different pump and line infrastructure. From today’s perspective, investments in reforms aimed at establishing more efficient irrigation systems, such as sprinkler or drip irrigation, appear more efficient and sustainable. This option was discussed during the project appraisals; however, it was understandably abandoned in view of the high water availability at the time and the high cost of changing an irrigation system.

Figure 1: Revised impact model for the project phases



In the appraisal for phase I, the experience and capacity of the partner – the Mechanical and Electrical Department (MED) of the Ministry of Water Resources and Irrigation (MRWI) – were rated high, an opinion shared by the World Bank, who was also active in the sector. Based on this, the MED assumed a high level of responsibility for implementing the project, including selecting and planning the pump stations, dealing with the tendering processes, and monitoring the construction and installation work. This appraisal had to be revised following experience in the early stages: the project participants interviewed for this evaluation all confirmed that the MED and pump station employees exhibited some major shortcomings in the areas of planning, management, operation, and maintenance. The basic and advanced training measures implemented in phase II aimed at reinforcing the responsible partner in the area of construction and operation were based on a coherent analysis of its specialist expertise. These measures were already considered in phase I, and then integrated into the project in phase II.

The establishment of basic and advanced training measures and the insistence on using an implementation consultant in phase II show that the organisational experience from phase I was used in a positive light for designing phase II. Given the substantial implementation problems in phase I, however, it is important to critically examine whether phase II and thus extended funding should have been approved in view of these experiences. At the time the appraisal order for phase II was issued to KfW in 2001, phase I was already heavily delayed: despite the project having started at the end of 1999, no construction measures had begun by this point, for example.

The pump stations were selected based on the size and urgency of the specific need for refurbishment. Clear criteria were agreed between KfW and the MED, which the MED used as a basis for submitting proposals that were then assessed by KfW. The criteria were based mainly on the technical and structural condition of the pumps and pump stations and on the changing irrigation and dewatering needs, e.g., altered borders of catchment areas or cultivation plans. However, a conclusive assessment cannot be made ex post as to how systematic and needs-based the MED's approach to prioritising the pump stations was. Two observations call this into question: (i) the deprioritisation and addition of new pump stations over the course of the project, and (ii) the current revision of the master plan, a systematic process for recording the condition and refurbishment needs of all stations, which will make the selection process more transparent and faster in future. From the partner's perspective, the latter is a lesson learned from the project.

The project's relevance is therefore rated fundamentally good with slight limitations regarding the MED's internal system for prioritising pump stations and with regard to the appropriateness of extending the funds despite substantial implementation problems.

Relevance rating: 2

Coherence

Internal coherence

In 2001, the German and Egyptian governments set out the medium-term priorities for German DC in Egypt in a priority area strategy paper for irrigated farming. These priorities included 1) System protection and expansion of drainage, 2) Expansion of the existing irrigation system with the goal of saving water, 3) Improvements to water quality, 4) Increased participation in water and land usage planning, 5) Reduction of state influence and empowerment of private institutions, 6) Water savings through improved management of demand, and 7) Use of export opportunities from the new EU Association Agreement. The content of the project evaluated here contributed in particular to the first two priorities.

According to today's benchmarks, the project fits in well with the strategic reference framework of the BMZ 2030 reform concept. The most important goal in the BMZ 2030 reform concept is to overcome hunger and poverty and reach the 17 Sustainable Development Goals. The core topics in German development cooperation include food security, rural development, and agriculture, including soil protection. In this context, the project contributes to SDG 1 "No Poverty", SDG 2 "Zero hunger" and SDG 9 "Resilient infrastructure and sustainable industrialisation".

Despite extensive crossovers in content, the evaluation found no indication of any close coordination or even cooperation with other German DC projects. The "Irrigated Agriculture Reform Programme", which was run by Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH between 2015 and 2019, for

example, aimed to achieve more efficient use of water in agriculture through integrated water resource management. This project included, for instance, training courses for running and maintaining pumps and pump stations. Cooperation and use of potential synergies did not take place.

External coherence

The national strategies for Egypt's agricultural development are influenced by the existing irrigation system, i.e., surface irrigation, limited water resources, rising demand, and agricultural limitations caused by geographical factors. At the start of the project, the primary aim was to ensure the return flow of water and irrigation efficiency through improved lines, pumps, and the use of sprinkler irrigation in parts of the country. The project fits in with both strategies. In 2016, "Egypt Vision 2030" set out the goal of sustainable development as a guarantee for growth, development, and prosperity for future generations. The Egyptian Vision is built on ten pillars; the development of irrigation and agriculture do not play a central role in the vision, though it is an important tool for target achievement, particularly the reduction of poverty ("Economic development" pillar) and the differences in income between urban and rural areas ("Social equality" pillar). The projects therefore also blend in well with this newer strategy.

The projects did not cooperate directly with other donors. According to project participants, regular conversations with the World Bank, the African Development Bank and the European Investment Bank took place during all on-site visits, and regular exchanges also took place (particularly in sectoral task forces). As a result of these activities, joint responses were given to partners and the same implementation consultants could be used. Beyond this, however, there is no other indication of mutual learning or close cooperation. This is particularly apparent for phase I, which was implemented as parallel financing to the World Bank project "Third Pumping Stations Rehabilitation Programme". The evaluation was only able to identify coordination in relation to the selection of pump stations, as conveyed via the partners.

While designing the phases, attention was paid to ensuring existing systems and structures were used and strengthened as far as possible. The measures were incorporated into the relevant structures in Egypt's administrative bodies and complemented the MED's own efforts, which aimed to improve irrigation and dewatering infrastructure, also in its work with other donors. For instance, responsibility for preselecting and prioritising the pump stations to be refurbished was assigned centrally to the MED.

From an expert's perspective, closer cooperation would have been recommended given the projects' similarity and the interdependent links within the irrigation and dewatering system.

Given the failure to harness potential synergies with other donors and projects, in particular within German DC and the World Bank, coherence is rated satisfactory but still below expectations. The use of local systems and structures and coordination by the partners are deemed positive.

Coherence rating: 3

Effectiveness

At outcome level, the two project phases pursue different, albeit related, objectives. Phase I aimed to "reduce the water table in order to avoid water-logging and soil salinity by removing drainage water", while phase II set out to "secure affordable irrigation and dewatering for farmland served by the pump stations incorporated into the project." Both packages of measures (with the exception of basic and advanced training measures) were based on the same results chain. For this reason, in the further analysis the objectives are regarded as fundamentally congruent, even though just one indicator (and thus, not enough) was defined for phase I.

The data provided by the Egyptian partner was generally inadequate. In the end, the plausibility of the indicators' achievement could only be verified during the final inspection through visits to the pump stations, while during the evaluation, this was through partner interviews, visits to the pump stations, 18 interviews with pump station directors and employees, and five focus group discussions with eleven local farmers.

Furthermore, this evaluation is based on the use of several, imperfect proxy indicators. Firstly, the water supply could not be measured, which is why estimates from local farmers were used. Secondly, data regarding the water table from the MWRI's Ground Water Sector was only collected in aggregated form over

extended intervals, which is why this evaluation uses an approximation of the measured water level within the stations. Thirdly, it was not possible to review any longer term operating and maintenance data from the pump stations. Instead, it is plausible to assume the pump stations worked effectively and the objectives were achieved provided no discrepancies arose during the on-site visits.

Table 1 presents the project's target indicators, the target level, and their status at the time of the final inspection. Furthermore, it shows the reformulation of indicators during this evaluation and the assessment of target achievement at the time of the EPE, as well as the underlying information and data sources. To sum up, it shows that 1 objective was achieved, 1 was partially achieved, 1 was basically not achieved, and 1 was not achieved at all.

Table 1: Indicators and target achievement at outcome level

Indicator	Target level	Status at final inspection (2019)	Status at EPE (2021)
(1) Water supply in the catchment area corresponds to the irrigation schedule (only phase II)	Achieved	Achieved for all commissioned pump stations	Not achieved for the random sample: - Comparison with the irrigation schedule not possible - Farmers served by irrigation station (El Thawra) describe inadequate irrigation. - According to the interviewees, low irrigation is attributed to an insufficient water supply, not to the station.
(2) Water table in the pump stations' entire catchment area below ground level	> 1 m	Achieved for all commissioned pump stations	Achieved for random sample of dewatering stations visited: - Smallholders report only small-scale problems with crop losses due to water-logging - In all stations, the water level in the inlet canal and intake nozzle is at least 1, often more than 2 m below ground level - No data on the water table available.
(3) Average system efficiency rate of pumps in operation (only phase II)	Meets manufacturer's specifications at the very least	Achieved for all commissioned pump stations	Partially achieved for random sample. The system efficiency rate of the pump stations visited in the random sample varies between 70 and 85%. A comparison with the manufacturer's specifications was not possible.
(4) The design documents are professionally prepared. Project implementation leads to the planned outcome within the planned time period (only phase II).	Yes	Partially achieved	Not relevant for the EPE as the indicator relates to processes in the course of the project.

(5) Pump stations are run efficiently, maintenance work is performed properly and on time (only phase II)	Yes	Partially achieved	Partially achieved for random sample: - Two stations and equipment in good condition - Two stations (Saft and Bahr El-Baqr) with slight deficiencies: secondary equipment in need of maintenance, such as cranes, barriers and gates. - One station (El Thawra) with more major deficiencies: one pump being repaired, equipment to remove plants from the inlet canal not working, no lubrication system, partial oil coverage of soil (occupational safety risk)

Based on the information available, at the time of the final inspection both phases had reached their objectives with their measures to invest in tangible assets.

Indicator 1: During the final inspection, the achievement of the indicator resulting from the refurbishment was found to be plausible. However, in the EPE, farmers reported inadequate irrigation, which can be attributed to an insufficient water supply and not to the station. The reason for this deviation is the different data collected.

Indicator 2: During the final inspection, the indicator's achievement was found to be plausible. In the EPE, this was roughly confirmed. In all dewatering pump stations visited, the water level measured in the inlet canal and intake nozzle was at least one metre below ground level, and more than two metres in most cases.

Indicator 3: The indicator was met at the time of the final inspection. Since then, there have been losses in efficiency due to ageing, meaning that the pumps now operate with a system efficiency level of roughly 70 to 85 percent. A comparison with the manufacturer's specifications was not possible due to a lack of data.

Indicator 4: The indicator relates to planning documents and processes during the project period, which means it is not relevant for the EPE. It was rated as partially achieved for the final inspection.

Indicator 5: The indicator was partially achieved at the time of the final inspection. The data from the EPE confirms this. For instance, major pump operation and maintenance deficiencies were identified in just one station (El Thawra). There were more minor deficiencies in secondary equipment in two other stations.

Despite the sparse data situation and the use of proxy indicators and random samples, the assessment of the refurbishment's effectiveness is relatively sound as the stations were not (sufficiently) functional prior to the start of the project. It is therefore highly likely that improvements to irrigation and dewatering can be attributed to the technical refurbishment. The condition of the irrigation and dewatering canals and the drainage system in general also influences this causal relationship as this can have both a positive and negative effect on the degree of target achievement. Assurance of the proper functioning of these systems was not within the project's sphere of impact and is outside the MED's institutional remit. In the areas surrounding the pump stations visited in the EPE, no indication was found that the inlet and outlet canals were not adequately maintained. It is therefore assumed that there are no negative reciprocal effects here.

The basic and advanced training measures were never assigned quantifiable variables, meaning that an assessment based on pre-specified criteria is not possible. Furthermore, no reliable data could be obtained for assessing effectiveness. However, the use of multiple consultants, which was the very factor that enabled the building to progress and many pump stations to be handed over in the first place, is an

indication of existing deficits, and therefore infers that the measures' effectiveness was limited. Assessing the actual causal effect of these measures is difficult ex post: For example, during the visits, the team did not identify any pump station employees who had participated in any such measure or who was able to evaluate this from an outsider's perspective. Furthermore, a number of influencing factors affect the ability of those who have received training to apply their knowledge in practice. These factors include, in particular, staff fluctuation and, if relevant, a lack of budget for operation and maintenance.

A decision was made to reduce funds not yet tied to delivery and service contracts during intergovernmental negotiations in June 2016 after the Egyptian partner declined to extend the implementation consultant's contract beyond 31 March 2014 and a retendering process failed. As a result, construction work already started was finished, but the planning of additional pump stations was brought to an end. Since the selected indicators relate only to refurbished pump stations and not to the absolute number of stations, this reduction in funds did not affect the reported target achievement. However, beyond these indicators, it must be noted that, as a result of the funds reduction, the project only refurbished 14 of the 21 planned pump stations, meaning that the target group reached was substantially smaller and the level of effectiveness achieved was lower.

In addition to the impacts within the context of the project objective, the projects also caused unintended (environmental) costs. Instead of replacing pumps and equipment or completing repair measures for the purpose of "refurbishment", brand new pump stations were built in three locations in phase I and in all locations in phase II. In many cases, these are located directly next to the old stations; in a few cases, these continue to be operated despite lower efficiency. According to the final inspection, this applies to Ghoreira and Benban (at the very least). In addition, project participants report that the pumps are planned, operated, and maintained with little concern for the efficient use of the pumps. This results in increased electricity consumption, and consequently, negative environmental effects.

To summarise, the target achievement of both phases is rated as satisfactory but below expectations. Where refurbishment of the pump stations actually took place, it was successful. Furthermore, as only 14 of the 21 pump stations originally planned were refurbished, the project failed to reach the initial level of ambition. However, much more light certainly could have been shed on the level of target achievement with additional systematic data regarding the baseline, project progress and project completion (e.g. on the water table, the water supply, or returns).

Effectiveness rating: 3

Efficiency

Both phases were significantly delayed from the outset (see table 2): the term of phase I lasted five instead of twelve years, while phase II lasted four instead of fourteen years. The delays between the financing agreement and the start of construction work (phase I) and between project appraisal and the signing of the financing agreement (phase II) are particularly striking.

Table 2: Timeline of milestones

	Phase I	Phase II
Project appraisal	1998-12-22	2001-12-28
Financing agreement	1999-10-03	2006-06-13
Mobilisation of international consultant (planned)	2004-11-14	2006-01-01 (2004-11-14)
Actual start of construction work (planned)	2007-01-01 (1999-07-01)	2009-03-20 (2006-06-28)

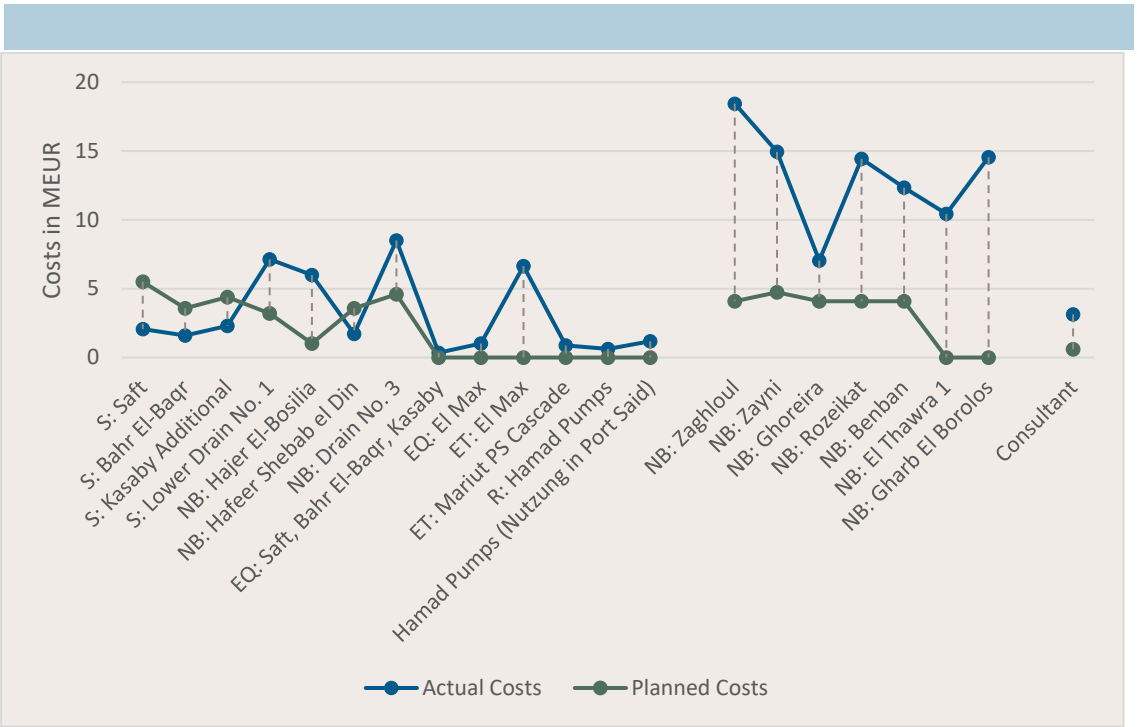
Actual end of construction work (planned)	2018-06-30 (2004-06-30)	2018-06-30 (2010-09-30)

These major delays significantly reduced implementation efficiency and can be traced back, in particular, to major difficulties in the cooperation between KfW and the MED, which has been explained on DC's part by a lack of capacity at the partner. Planning and tender documents were often inadequate or defective; awarding procedures had to be repeated or adjusted, causing huge losses in time and revision loops. The implementation consultants played a central, active, and positive role; however, friction during cooperation as well as communication and information sharing between the consultants and the MED made the project more difficult to plan and run. Further delays arose during the construction as a result of poor quality building work, deficient drawings or liquidity problems, and political unrest, which brought state institutions to a standstill for several months in 2011.

Due to huge rises in prices for building work during the course of the project, the delays led to cost increases. Despite the project ending early, meaning that the number of stations refurbished fell from 21 to 14, the total costs for the two phases amounted to EUR 135.45 million instead of the original proposal of EUR 79.24 million. Figure 2 shows the planned and actual costs for the 14 refurbishments, the procurement of equipment and spare parts, consulting services in phases I and II, as well as repairs in phase I (left) and phase II (right). The figure shows 1) high absolute and relative variation in cost deviations between the individual refurbishments due to a wide array of measures (replacement of technical equipment through to brand new buildings), as a result 2) significantly higher absolute deviations in phase II due to increased local construction costs and 3) relatively low costs for consulting services.

Since the construction work to the buildings was financed from the partner's own funds, the counterpart contribution in particular rose significantly (EUR 96.76 million in total instead of EUR 24.91 million), while the DC contribution remained below the planned EUR 56.24 million at EUR 38.79 million. The deviation in the DC contribution can be attributed to both the lower costs for the implemented refurbishment measures, and the lower number of refurbished pump stations.

Figure 2: Costs for refurbishments and consulting services



Note: The figure shows the costs for the 14 refurbishments, the procurement of equipment and spare parts, consulting services in phase I and II and repairs. Phase I is shown on the left, and phase II on the right. R: refurbishment, NB: new building, EQ: procurement of equipment, SP: procurement of spare parts, R: repairs.

Additional unforeseen costs and losses in efficiency arose because some pieces of technical equipment (pumps, sensors, etc.) were ordered years before construction work started and were not stored properly, or no longer corresponded to the relevant standards when construction work started.

The significantly increased costs and the simultaneously reduced target achievement led to the project's production efficiency falling sharply. In line with this, the overarching developmental impacts also remained significantly below the initial level of ambition (see below), resulting in a markedly lower allocation efficiency being measured.

The use of synergy effects between phase I and phase II is regarded as having a positive impact on economic efficiency. Firstly, phase II relied on established criteria and processes, e.g., in relation to the selection of pump stations or international tendering processes. Secondly, the consulting services resulting from phase I – which came at a relatively low cost – could probably have avoided relatively high losses in economic efficiency, both in phase II and phase I after the MED agreed to expanding the consultant's contract to this phase. Thirdly, some transaction costs could have been saved as the stations in the two phases were close both geographically and in terms of content.

It was not possible to conclusively determine whether the project's similarity with projects run by other donors, such as the European Investment Bank or the World Bank, could have led to similar synergy effects: however, close cooperation and potential gains in economic efficiency were not achieved. The exception here is the contracting of some of the same consultants, which facilitated efficiency gains resulting from cost savings and the transfer of expertise.

The economic efficiency of investment in fixed assets is difficult to evaluate in retrospect. The need for the extent of the individual refurbishments cannot be reviewed from today's perspective. One positive element to note is that investments were issued using transparent, international (pump equipment) and local (building orders) tendering processes.

In terms of the appropriateness of the installed capacities, there are two opposing perspectives to consider: on the one hand, the capacities are often over-dimensioned from a purely technical perspective.

This is particularly true in locations where new stations were built next to old pump stations that are still in operation. Both at the time of the final inspection and during the on-site visits for this evaluation, only one or two of the installed, functional pumps were running in some cases. As an example, operating data for the Zaghloul pump station confirms that only one pump was running on a total of 34 of 55 days in October and November and that there were no days on which all pumps were running. Here it must be noted that the visits took place in early winter, a period when less irrigation water tends to be moved in general. For months with higher water volumes, it is expected that more pumps will be running, though at least one pump is kept as a spare in all locations.

On the other hand, the project appraisal noted that the MED's maintenance budget was very low and anticipated more frequent repairs instead of regular maintenance. This would result in a swift fall in the pumps' efficiency rates and frequent failures. Due to the associated losses in capacity, over-dimensioned capacities could theoretically be regarded as appropriate in practice; the over-dimensioning of capacities would also allow operating periods to be reduced, thus extending the useful life. Contrary to this expectation, the efficiency rates of 70 to 85 percent reported during the on-site visits without any major abnormalities related to operation and maintenance suggests that maintenance is appropriate and that there have been few losses in capacity to date. The installed capacities are therefore regarded as being over-dimensioned from today's perspective.

Due to the significant delays, high additional costs with a lower level of target achievement, and over-dimensioned pump capacities, the project's efficiency is rated as unsatisfactory on the whole. Positive reference is made to the synergy effects between the two phases and the lessons learned from phase I.

Efficiency rating: 4

Impact

The impact-level objective was to "contribute to protecting and increasing agricultural revenue and income in the pump station catchment areas". For example, the goal was for the refurbishment measures to increase revenue by five percent in 60 percent of the 216,000 local businesses. There is no rationale provided for the definition of these target values. It is also striking that only revenue was supposed to be measured, not income. See figure 1 for an in-depth results chain.

Table 4: Indicators and target achievement at impact level

Indicator	Target level	Status at final inspection (2019)	Status EPE
Agricultural revenue in the pump station catchment areas from year 3 following commissioning of the refurbished station	5% increase at 60% of businesses	Assumed plausible	Mostly achieved: Achieved in four out of the five pump stations visited

At the time of the final inspection, no data was available concerning the local population's revenue and income development. For this reason, the target achievement plausibility was rated likely due to the successful refurbishments. Since it was only just possible to verify the plausibility of the project's outcome-level objective, this conclusion is subject to a great deal of uncertainty.

In the EPE, it also was not possible to use secondary data regarding local revenue and income development because no data had been collected systematically or to a sufficiently sophisticated level by either state authorities or the majority of smallholdings. For approximation purposes, this evaluation uses interviews with eleven farmers in the areas surrounding five refurbished stations. The results directly examine the impact-level objective but certainly are not representative for other businesses or catchment areas and may be distorted (e.g., recall bias, social desirability bias). Furthermore, they cannot be used to confirm a final causal link due to a lack of comparative scenarios, significant changes in the sector and long time frames.

The interviews broadly suggest positive effects. Firstly, local farmers reported significant reductions in crop losses and attributed these to the refurbishment work. Prior to the refurbishments, pump failures were mostly caused by a high water table/water logging and soil salinity of between 20 and 30 percent, or even as high as 50 percent in Zaghloul's catchment area. Secondly, all participants reported that the drainage system was very reliable. As a result, field yields could mostly be increased by about 20 to 30 percent due to irrigation, i.e., the target level of five percent was clearly exceeded. However, no increased revenue was generated in the El Thawra irrigation station's catchment area as the volume of water was the limiting factor here and could not be increased through the station's refurbishment. Another restrictive factor to be noted here is that increased revenue could also be traced back to more efficient farming methods. Thirdly, some participants reported positive impacts on farming methods and efficiency: in the area surrounding El Zayni, the duration of field work dropped, and the annual growing seasons increased from two to three. These effects were limited because for irrigation purposes farmers use drainage water that already has increased salt concentration; for this reason, a transition to more salt-resistant sugar beets took place. Changes in income were not examined due to the high level of dependence on external factors.

Despite these partially positive effects on agricultural revenue, the lower number of pump stations actually refurbished significantly reduced the overarching developmental impact intended. This is therefore rated as satisfactory, but below expectations.

Overarching developmental impact rating: 3

Sustainability

In principle, it can be assumed that investment in physical assets has a sustainable impact.

The irrigation and dewatering system is a central piece of infrastructure for the Egyptian agricultural sector, and one which is funded completely by state budget allowances. Due to smallholders' low income and the political and social significance of the irrigation system, user participation plays no role, and will not in the future either.

The biggest risk to sustainability arises from maintenance and repair work to the infrastructure by the MED staff. The low maintenance budget, the lack of sufficiently trained staff and a repair-over-maintenance approach are regarded as causes for concern. During the project's implementation, deficiencies were regularly detected in pump operations, such as the overriding of automatic shut-off devices or excessive vibrations and cavitation.

KfW deployed a range of measures to improve sustainability: all tendering processes were carefully supervised, equipment and building work were quality-tested by consultants, and pumps were not accepted and started up until approval and in the presence of two short-term experts. As such, it can be assumed that the construction work and installations were of a high standard when handed over:

The results of pump station investigations for the EPE were positive: 1) maintenance work appeared to take place regularly, to a sufficient level and on a preventive basis, 2) local staff in the pump stations regarded the maintenance budget as generally sufficient, 3) in contrast to past experience of the pump stations' acceptance, no cases of overriding or faulty pump operation were identified, and 4) sensors installed to identify operating problems were functioning. However, there was also some criticism regarding 1) a lack of modern SCADA systems in almost all pump stations (in the Saft pump station a system did exist, though it was not working) and 2) a lack of flow meters in the pump stations. Both reduce the efficiency, and as a result, the sustainability of the stations.

It was not possible to conclusively determine the extent to which sustainability risks were actually reduced by basic and advanced training measures. At the pump stations visited, none of the staff currently working had taken part in advanced training measures. Knowledge and skills are mainly passed on through on-the-job training. The biggest challenge is said to be low staff availability for operation and maintenance, particularly younger employees. By contrast, the MED believes itself to be well equipped with a sufficient number of staff, good internal knowledge sharing and differentiated, implemented maintenance plans; however, rising prices for spare parts with a maintenance budget that stays the same presents a challenge. It therefore appears as though basic and advanced training measures only reach a small number of employees and their impact has mainly been limited to staff within the MED. An alternative explanation is

that trained specialists are no longer employed in the pump stations due to staff fluctuations. The predominantly positive results relating to the pump stations' maintenance indicate that knowledge was shared accordingly, or training was not needed, or it was secured by other means.

Other likely risks to sustainability arise from climate-related and political changes and dependencies. As a result of climate change slightly higher rainfall is anticipated, but with longer periods of drought and heat. In addition, the FAO expects the volume of water needed from the Nile for agriculture to rise by 15 percent by 2050 (FAO 2011). Water scarcity in the region is increasingly leading to political tensions. The ten countries along the Nile who form the Nile Basin Initiative are therefore seeking joint responses to increasing water demand contrasted by consistent or falling water availability (Mandela 2021). Due to its geographical location, Egypt is dependent on the more southerly countries beside the Nile, who are demanding a larger proportion of Nile water for their growing populations. According to information provided by Egypt, it is already 30 billion m^3 of water short, and the construction of the Ethiopian Renaissance Dam is likely to lead to a further reduction in available Nile water (Takouleu 2020). Potential means for reducing risks include the development of new water sources, technical progress and efficiency gains in irrigation and agriculture; in recent years, the Egyptian government has passed an increasing number of measures to reduce water consumption and develop new water sources (e.g., using water treatment plants) and has restricted the farming of water-intensive plants.

In view of this situation, the financed irrigation and dewatering system's high volumes of water are relevant for its proper and efficient functioning. Sprinkler irrigation achieves a higher degree of efficiency, still works even when water volumes are lower, and does not require any drainage (as no excess water is generated). This could result in significant savings in infrastructure and electricity costs. During the projects' implementation periods, KfW was already supporting a switch to sprinkler irrigation with the project "Improvement to the irrigation system" (BMZ-No. 1995 65 524) and the Egyptian government initiated an incremental reform of the entire irrigation system. The pump stations refurbished in the projects, particularly those used for dewatering, will no longer be needed if this switch is made. Experts estimate that this switch will take 20 to 30 years. Given the magnitude of the Egyptian irrigation system and the current slow progress of this switch (Fethi Lebdi. (2016)) it can therefore be assumed that the pump stations will have already reached their technical useful life before they can be regarded as redundant with the arrival of the new system.

The project's sustainability is thus rated as good.

Sustainability rating: 2

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

Projects are evaluated on a six-point scale, the criteria being **relevance, coherence, effectiveness, efficiency, overarching developmental impact** and **sustainability**. The ratings are also used to arrive at a **final assessment** of a project's overall 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.

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 overall objective ("overarching developmental impact") and the sustainability are rated at least "satisfactory" (level 3).