

Ex-post evaluation

Water Supply and Wastewater Disposal Granada, Nicaragua

Title	Water Supply and Wastewater Disposal Granada				
Sector and CRS code	Water, sanitation, and wastewater management, 14020				
BMZ number	2002 66 510, 1930 03 548				
Commissioned by	BMZ				
Recipient and executing agency	Ministry of Foreign Affairs (Ministerio de Relaciones Exteriores, MIN-REX) / national water and sewage company (Empresa Nicaragüense de Acueductos y Alcantarillados, ENACAL)				
FC financing volume and instrument	EUR 12,92 Mio. FC-subsidy and EUR 14,5 Mio. FC-loan				
Project duration	2006-2021	Reporting year	2025	Year of random sample	2023

Project objectives and implementation

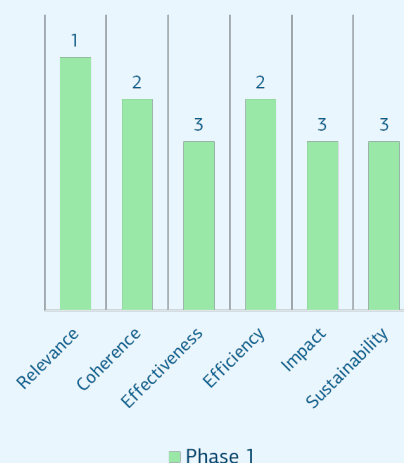
The objective at the outcome level was to contribute to continuous, environmentally sound, and economically efficient water supply and wastewater disposal (WS/WD) in the city of Granada (Outcome). It thereby intended to improve the health of the local population and protect the ecosystem of lake Cocibolca (Impact). The project activities included the rehabilitation and expansion of the WS/WD systems, as well as institutional strengthening and decentralization of the executing agency, and awareness raising among the population through public campaigns.

Key findings

The project substantially improved the city's water supply and sanitation and served different socio-economic population groups of Granada. The lessons learned by the executing agency can plausibly be replicated in other parts of the country.

- The project relevance was very high: it installed a robust, low-maintenance, and cost-effective technology and addressed institutional and social needs. It responded dynamically and sensibly to changing needs.
- Thanks to systematic learning from previous projects, clear integration into national priorities, and committed and established cooperation between all stakeholders, the project was highly coherent.
- The quality of the water supply was significantly improved and the wastewater disposal substantially expanded. Collection efficiency, operating cost coverage, and connection rates were significantly increased. However, despite successes, water losses remain too high and some of the monitoring data was not fully traceable.
- Positive effects of the project on the health of the population are plausible but not quantifiable.
- Both the costs and the implemented measures increased significantly in the course of the project. Allocation efficiency was good by international standards.
- The sustainability of the project depends on the future allocation of human and financial resources for operation and maintenance of the systems, as well as on further reductions in water losses and increases in connection rates and payment discipline.

Overall rating successful



1: very successful – 6: completely unsuccessful

Conclusions

- Public-private operating models can ensure effective commissioning and operation of the plants and provide valuable learning experiences for the public, executing agency.
- Dedicated monitoring by the executing agency and tracking of indicators by German Financial Cooperation beyond the end of the project improves operational management.
- Robust, low-maintenance technologies contribute to the sustainability of investments.
- Consistent and committed project partners who maintain close direct contact are key factors of success.

Contents

List of abbreviations	3
Overview	4
General conditions and classification of the project	4
Brief description	4
Breakdown of total costs	5
Map of the project region	5
Project-specific strengths and weaknesses of the project	6
Assessment according to OECD DAC criteria	7
Relevance	7
Coherence	10
Effectiveness	11
Efficiency	19
Impact	21
Sustainability	23
Overall assessment	26
Contribution to Agenda 2030	26
Methodology	27
Evaluation methodology	27
Assessment methodology	29
Imprint	
Appendices	

List of abbreviations

A+F	Training and further training measures
ANA	Autoridad Nacional del Agua
BMZ	Federal Ministry for Economic Cooperation and Development
CNRH	Consejo Nacional de los Recursos Hídricos
CRAI	Centros Regionales de Atención Inmediata
DAC	Development Assistance Committee
DAC	Development Assistance Committee
DC	Development Cooperation
DDG	Delegación Departamental de Granada
ENACAL	Empresa Nicaragüense de Acueductos y Alcantarillado Sanitario
EPE	Ex-post evaluation
EUR	Euro
FC	Financial cooperation
FC E	FC Evaluation
GDP	Gross domestic product
GIZ	German Society for International Cooperation
HDI	Human Development Index
MARENA	Ministerio de Recursos Naturales y Ambientales
MINREX	Ministerio de Relaciones Exteriores
MINSA	Ministry of Health
MP	Module proposal
NRW	Non-Revenue Water
O&M	Operation & Maintenance
OECD	Organisation for Economic Co-operation and Development
ONA	Oficina Nacional de Acreditación
PA	Project appraisal
PCR	Final completion report
PP	Project proposal
SIGIL	Sistema de Información Geográfica para la Integración de la Logística
TC	Technical cooperation
ToC	Theory of Change
UASB	Upflow Anaerobic Sludge Blanket
USD	US dollar
WS/WD	Water supply and wastewater disposal

Overview

General conditions and classification of the project

The project was intended to improve the drinking water supply and wastewater disposal in the Nicaraguan city of Granada. Granada is located on the shores of freshwater *Lake Cocibolca* (or Lake Nicaragua), with a surface of 8,264 km² the largest lake in Central America. The colonial city was founded in 1524 by Spanish colonizers and, as the former capital of Nicaragua and one of the oldest cities in Central America, is of great historical importance. Thanks to its well-preserved colonial architecture, art, music and nature, the city is also of great touristic and thence economic importance for the country today.

The recipient of the project was the Nicaraguan Ministry of Foreign Affairs (*Ministerio de Relaciones Exteriores*, MINREX). The executing agency and project partner was the national water and sewage company (*Empresa Nicaragüense de Acueductos y Alcantarillado Sanitario*, ENACAL). ENACAL, founded in 1998, is a state-owned commercial enterprise responsible for water supply and wastewater disposal (WS/WD) in urban areas and, since 2015, also in rural areas, in particular for monitoring drinking water quality and compliance with national wastewater treatment standards.

Brief description

The objective of the project was to contribute to a continuous, hygienically and ecologically sound and economically efficient water supply and wastewater disposal system in the city of Granada (outcome objective). At an overarching development policy level, it was intended to improve the health of the population of Granada and the sustainable protection of the *Lake Cocibolca* ecosystem (impact objective). The target group was the population of the city of Granada; in 2020, this was 131,000 people. ENACAL contracted an implementation and management consultant to provide support and, over the course of the project, a private operator for the operation and maintenance (O&M) of the facilities.

The project comprised the rehabilitation and expansion of the water supply/sewerage systems in Granada along three project components. Firstly, the main investment financed the following construction components: i. Expansion of the sewage network, ii. Expansion and optimisation of the existing pond treatment plant with UASB reactors, iii. Expansion of water supply. Secondly, an accompanying personnel support measure (training measure) was to support the project executing agency in operating the rehabilitated or expanded water supply and wastewater treatment systems independently, efficiently and sustainably in economic and technical terms. Thirdly, accompanying publicity campaigns were to contribute to raising the population's awareness of ecologically and economically sustainable water usage and wastewater disposal and to increase the connection rate.

The project was appraised in 2006, but actual implementation only began in 04/2008 and ended with the final inspection in 05/2021, meaning that the project lasted around 13 years instead of the originally planned 4 years, partly due to significant increases in funding.

The costs of the project at final inspection totalled EUR 34.7 million, of which EUR 27.2 million came from BMZ funds (78%), EUR 1.4 million from the Nicaraguan Ministry of Finance (4%), EUR 1.9 million from ENACAL funds (6%) and EUR 4.2 million from Japanese counterpart funds (12%).

Breakdown of total costs

	Phase 1 (plan)	Phase 1 (actual)
Investment costs (total) in EUR million	30,8*	34,7
Own contribution in EUR million	8,3	3,3**
External funding in EUR million	20,5	31,4***
of which BMZ funds in EUR million	20,5	27,2

Table 1: Breakdown of costs.

Note:

*includes EUR 2.46 million from interest differential funds.

**is made up of EUR 1.4 million from the Nicaraguan Ministry of Finance and EUR 1.9 million from ENACAL.

***includes EUR 4.23 million from Japanese funds.

Map of the project region

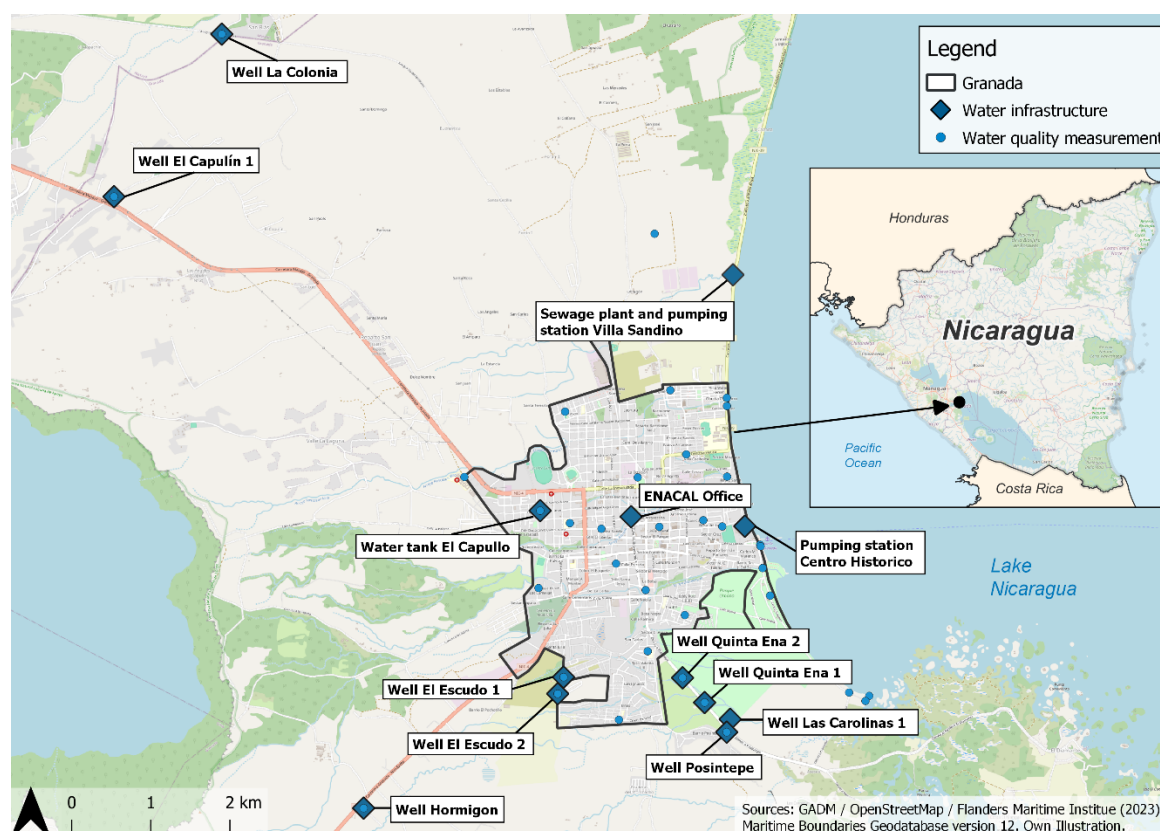


Figure1: Map of Granada including water and wastewater infrastructure and measurement locations.

Source: Own illustration.

The map shows the WS/WD systems of the city of Granada and its location on Lake Cocibolca (Lake Nicaragua). Among other things, the project supported the establishment of protection zones for several wells, the construction of the Las Carolinas 1 well and its pressure pipeline to the grid, rehabilitated the El Capullo water tanks, rehabilitated and financed the Centro Historico and Villa Sandino pumping stations as well as the UASB reactors at the sewage treatment plant and a new ENACAL office in Granada.

Project-specific strengths and weaknesses of the project

Note: The strengths and weaknesses are project-specific and relate exclusively to the specific project evaluated. The most important strengths and weaknesses of the project are to be listed here in the form of bullet points as complete sentences - insofar as lessons learnt can be derived from them. In contrast to the strengths and weaknesses, conclusions and lessons learnt are cross-project findings that can be derived from the evaluated project and may also be relevant for similar projects. They should be formulated as independent statements and be comprehensible as such. Generally applicable recommendations such as "The evaluation guidelines should be adhered to more strictly" are not suitable for this section. If generally applicable principles were disregarded in a specific project, this should be included in the evaluation report at the appropriate point as a shortcoming of the individual project, but not as a lesson learnt. Lessons learnt should not be formulated as recommendations, i.e. the use of the verb "should" should be avoided. For example: "Projects should implement a comprehensive monitoring system from the outset" becomes "The implementation of a comprehensive monitoring system from the outset enables measures to be adapted as required over the course of the project".

The strengths include in particular:

- A coherent project concept that holistically addresses infrastructural, institutional and public aspects.
- Robust and cost-efficient water supply and sanitation systems, through optimal utilisation of climatic and geographical conditions
- A clear geographical focus of the project on one city with clear responsibilities
- Long-term cooperation between Nicaragua and Germany in the sector and building on previous experience
- High and sustained commitment of the executing agency ENACAL and its management
- Close support from the implementation consultant and KfW (especially its local representative office), also beyond the AK; overall good cooperation between all parties involved
- Serious, ongoing dialogue with project indicators and monitoring
- The public-private operator model with the operating company and many years of experience with it
- High level of interest of the agricultural sector in the reuse of treated wastewater

The weaknesses include in particular:

- Institutional weaknesses: Insufficient personnel and financial resources at DDG, insufficient water and wastewater tariffs, high water losses (technical and commercial), inadequate implementation and documentation of technical and commercial operations.
- Limited experience of the executing agency in the wastewater sector and especially in the operation and maintenance of the UASB reactors and biogas production
- Low willingness to connect by the high-income population due to the colonial buildings and/or their residence abroad, low ability to pay by low-income households
- Limited "culture" of wastewater disposal and payment by residents
- Massive delays in project implementation
- Restrictions in 2018 due to political unrest and in 2020/21 due to the Covid-19 pandemic and resulting cost increases

General conclusions/lessons learned

- The actual potential of environmental impacts should be realistically assessed at project appraisal and categorised as prophylactic where appropriate.
- Indicators at impact level must be formulated and provided with baseline data in order to make overarching effects measurable. Official statistics on disease prevalence are often not specific enough.
- A temporary, private-public operator model can be a useful project component and ensure the sustainability of project effects under certain conditions (here: limited previous experience and high willingness to learn on the part of the public operator, close cooperation between the private operator and the public operator through the involvement of operator staff, clear exit and handover strategy).
- The development of adequate financing options/subsidies for low-income households is necessary in order to increase the connection rate to the sewage network ("last mile").

Assessment according to OECD DAC criteria

Relevance

1. Alignment with policies and priorities

In 2006 - at the time of the project appraisal (PA) - the project was directly and meaningfully embedded in the priorities of the Nicaraguan government and its high and increasing prioritisation of water supply and sanitation. The Nicaraguan water sector strategy of 2005 envisaged, among other things, i.) increasing the connection rate to the water supply and sanitation system, ii.) successively developing decentralised operator models to improve water services and iii.) ensuring the sustainability of water supply and sanitation systems. The sector strategy is directly linked to the national development plan (*Plan Nacional de Desarrollo Humano* 2008-2012).

The continuing high level of dynamism in the sector is also evident in the adoption of the Wastewater Law of 2007, which regulates the protection, control and management of all water resources, and its reform in 2010 (*Ley General de Aguas Nacionales* No. 620 and No. 1046). In addition, the "National Council for Water Resources" (*Consejo Nacional de los Recursos Hídricos*, CNRH) and the "National Water Authority" (*Autoridad Nacional del Agua*, ANA) were founded to ensure decentralised and integrated administration and management of water resources.

From today's perspective, the project's priorities remain highly relevant for the Nicaraguan government, as set out in the National Development Plan 2022 - 2026 (*Plan Nacional de Lucha contra la Pobreza y para el Desarrollo Humano*). The project is therefore in line with the Paris Declaration of 2005 (alignment).

Furthermore, the project design reflected the BMZ's orientations at the time of the PA, which is evident in the Latin America concept (see *Contributions to poverty reduction and state modernisation*), in the position paper "*Decentralisation and strengthening local self-government*" and in the 2015 action project (see *Guaranteeing basic social services and participation of the poor*).

2. Alignment with the needs and capacities of stakeholders and beneficiaries

According to the project appraisal, the target group of the project comprised around 100,000 inhabitants of the city of Granada, 48% of whom were male and 52% female. At the time of the project appraisal, around 57% of the population lived in the "simplest residential areas" (*zonas populares*) and 11% in the so-called "progressive areas" (*zonas progresivas*), which are characterised by newer buildings with minimal infrastructure and basic services. In addition, 28% of the population lived in the historic and touristy old town, which is considered a favoured residential area. Around 4% lived in uncontrolled poor neighbourhoods (*zonas precarias*), where basic services were mostly used unofficially.

The people interviewed as part of the ex-post evaluation (EPE) unanimously rated the necessity of the three project components as very high. The project identified a central problem in the city and addressed the needs and capacities of both the target group and the executing agency in an appropriate manner.

Firstly, the high need for investment in WS/WD was due in particular to the inadequate hygienic and hydraulic conditions in Granada before the start of the project. The situation was characterised by: i.) visible and smelly sewage on the streets of the city, due to a connection rate to the sewage network of only 6% of the population, ii.) infiltration of sewage into the aquifers, iii.) the direct or indirect discharge of wastewater into *Lake Cocibolca* via rainwater drains, which led to localised pollution, particularly at the two main inlets to the lake, , and iv.) a relatively high connection rate to the water supply of 94%, but with an unreliable supply (only around 5-6 hours a day, mostly at night) for 30% of households.

Secondly, ENACAL had structural and institutional weaknesses at the time of the project appraisal (PA), which manifested themselves, for example, in low operating cost recovery (2006: 65%) and high water losses (2006: 65%). The project envisaged the establishment of a semi-autonomous organisational unit within ENACAL, the "*Delegación Departamental de Granada*" (DDG). As a preliminary stage to decentralisation, this was to bundle the technical and commercial operating processes in the department of Granada under local management. The training measures strengthened the DDG in various areas, including commercial aspects (e.g. cadastral maintenance, billing, installation of water meters, monitoring), operational activities (e.g. O&M of infrastructure), administrative and financial tasks (e.g. accounting), personnel development and planning measures (e.g. information systems). They also included the construction and equipping of a new office and the purchase of transport for the DDG.

Thirdly, the implementation of information campaigns on doorsteps, in schools and via local radio stations was important both for the target group and for ENACAL. The campaigns were intended to inform the population about the project, get them involved in the upcoming construction work, increase their willingness to pay for the installation of wastewater house connections and promote the proper use of the systems (e.g. identification of leaks, separate waste disposal). In view of the population's lack

of experience with sewage systems and the frequent problems with connecting "the last mile", the inclusion of these activities was both sensible and necessary.

In general, the project was primarily aimed at households in Granada, which, according to the city administration, accounted for 92% of the buildings registered in the city in 2024. Particularly disadvantaged population groups were taken into account by focussing on low-income supply zones ("*zonas populares*" and "*zonas precarias*").

In addition, the executing agency took into account the low purchasing power of the target group in some neighbourhoods by i.) assuming the costs for sewage house connections from its own funds and ii.) using nationally differentiated index tariffs according to consumption and user type.

It is to be expected that women will benefit disproportionately from the project, as they are traditionally responsible for the household and caring for children. It is therefore plausible that women took part in the door-to-door information campaigns with above-average frequency. It can also be expected that female ENACAL staff also benefited from the training and further education measures (A+F). A further focussing of the concept on gender impact potential does not appear necessary or expedient, also from today's perspective.

The project is expected to gain additional relevance in the future due to climate-related water scarcity and extreme weather events caused by climate change (see e.g. droughts in Nicaragua in 2014-15 and 2018-19). The importance of protecting *Lake Cocibolca* is expected to increase, as it is not only of central importance for fishing and tourism, but also functions as the largest and strategic freshwater reservoir in Central America. The cities of *San Juan del Sur*, *Juigalpa* and *Las Salinas* already obtain their drinking water from the lake, and the 2022 - 2026 national development plan envisages extending the drinking water supply from *Lake Cocibolca* to other municipalities.

3. Appropriateness of design

Both at the time of the project appraisal (PA) and from today's perspective, the project design is considered appropriate and realistic. It was suitable for solving the core problems mentioned. The theoretical interplay of the three components, which was designed to tackle the problems at hand on a broad scale, deserves special mention.

Overall, the project's target system was sufficiently precise. However, a slightly adapted version of the overall objective (according to the appraisal report) was used as part of the EPE¹. In addition, minimal changes to the indicators were necessary during the course of the project. The values of the indicators corresponded to the context of Granada and the level of ambition was appropriate.

Figure 2 shows the project's Theory of Change (ToC) reconstructed as part of the EPE. The impact mechanisms and assumptions presented are largely plausible. These include positive health impacts from i.) improved health services provided by the hospitals/health centres/doctors' surgeries (see Impact) and ii.) reduced health risks. The improved living conditions and sources of income due to increased tourism potential (not included in the project's objectives) are also plausible. Only the theoretically expected effects at impact level for the ecosystem of *Lake Cocibolca* are assessed as minor. *Lake Cocibolca* was already an intact water resource at the time of the PA, with a high regeneration capacity thanks to its large surface and the high temperatures in the surrounding area, as well as the few towns and industries in the vicinity. It is therefore to be expected that the ecosystem would have remained intact even in the absence of the project.

The technical design of the infrastructure measures should be emphasised positively. The design of the infrastructure facilities optimally utilised the natural conditions. This created a very favourable water supply system in terms of energy, which opened up a new, very nearby well field that only requires disinfection for treatment and can be made available to the population with little pressure (energy). The sewer network drains a large part of the city purely via the natural gradient to the sewage treatment plant and even the two pumping stations only consume a small amount of electricity as the difference in altitude is favourable. The sewage treatment plant uses only natural processes that make full use of the favourable climate and therefore consume very little electricity, but is also very robust. These systems are inexpensive to purchase and enable cost-effective operation with low maintenance. In retrospect, there is no substantial potential for improvement in the technical design. It remains to be seen in the future whether it is economically viable to convert the sewage gas produced in the UASB reactor into electricity.

It is criticised that the time horizon of a total of 4 years for the (minor) project measures planned at the time of the project appraisal was based on over-optimistic planning.

¹ According to the AK, the impact objective was "Based on improved framework conditions for the sustainable management of water resources, the population's access to affordable and qualitatively appropriate drinking water and sanitation services is sustainably improved." This is in line with the original Development Cooperation (DC) programme objective. According to the appraisal report, the overall objective of the project was: "To contribute to improving the health situation of the population in the programme area by reducing waterborne diseases and improving the environmental situation through the sustainable management of scarce regional water resources and the protection of the Lake Nicaragua ecosystem."

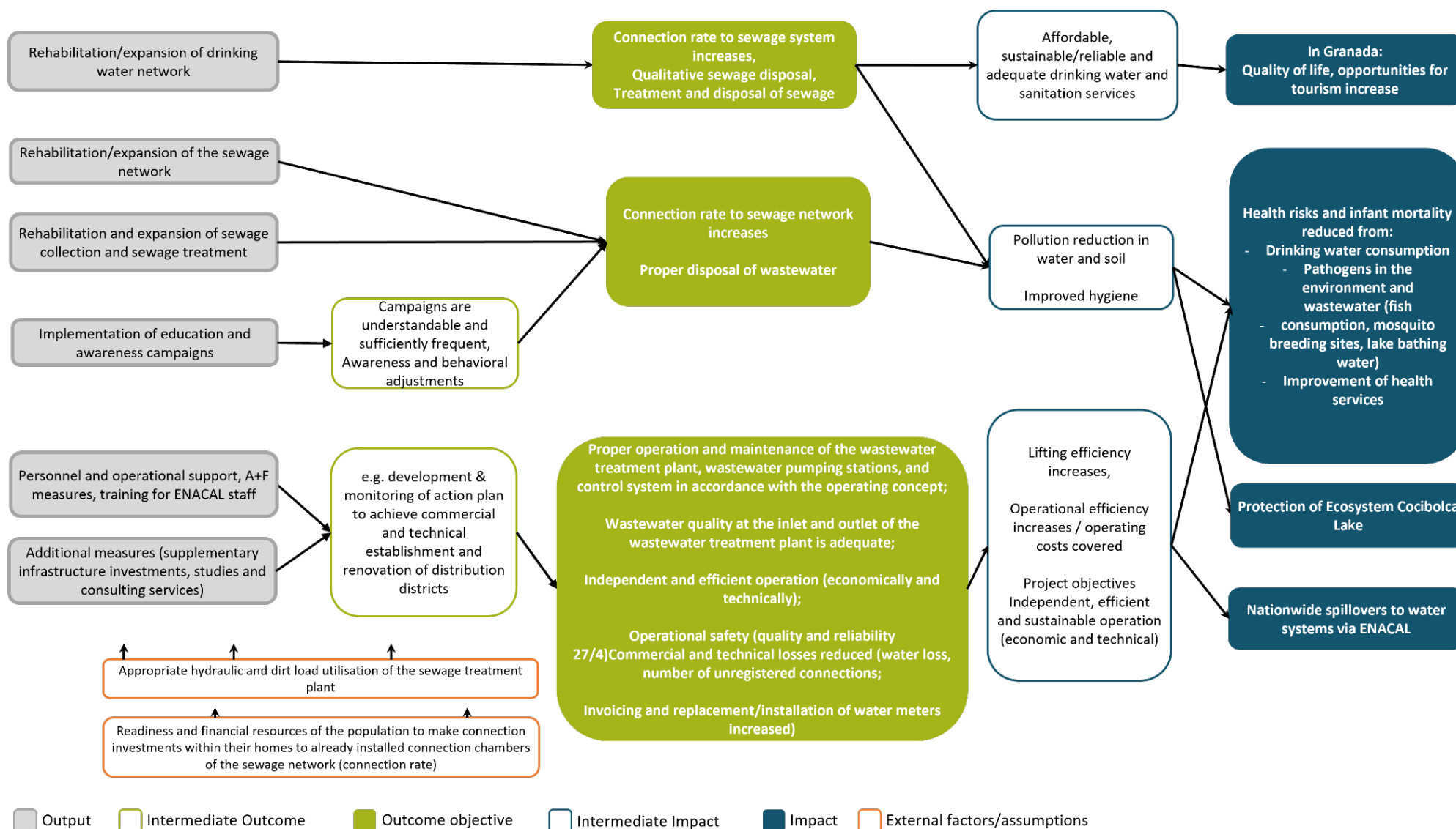


Figure 2: Theory of Change.

Source: Own illustration.

4. Adaptability – response to change

Several adjustments were made in the course of the project. Firstly, the tender for the grid construction, originally planned as one lot, was divided into several lots. This decision proved to be sensible as it enabled national companies to submit bids and keep construction costs low.

Secondly, a study conducted by the consultant revealed that one well in the city of Granada (*Quinta Ena 2* well) reached the maximum permissible nitrate level of 25 mg/l. As a result, the project was unable to fulfil its objectives. As a result, the project financed the drilling and equipping of the *Las Carolinas* well, allowing the *Quinta Ena 2* well to be shut down. The planning and implementation of this well investment made sense in terms of size and location and utilised the natural conditions of the site extremely efficiently. Both the identification of the deficient well and the development of the new well field are considered a great success, as they prevented the potential use of drinking water outside the permitted standards in good time.

Thirdly, due to inadequate O&M of the sewage treatment plant financed by the project, it was decided in the first year after its commissioning (at the suggestion of KfW through ENACAL) to commission a private operator with the O&M of the two pumping stations and the sewage treatment plant. This switch proved to be extremely sensible and important.

Fourthly, the buildings were extended several times as the actual rehabilitation and replacement requirements for the existing supply and disposal facilities rose from an estimated 33% to around 50%. This related in particular to an extended expansion of the wastewater treatment plant (construction of a second lagoon, equipping the second UASB reactor and additional equipment for mechanical pre-treatment with a fine screen), expansion of the sewer network in the catchment area of the *Centro Historico* pumping station near the lake and the construction of a pumping station from own funds to supply the nearby hospital.

Fifthly, in the final years of the project it became clear that the water losses and the low connection rate to the wastewater network were jeopardising the effectiveness and sustainability of the project. In response to this, the project focused more strongly on these two issues, in particular by including two additional indicators in the regular reporting, strengthening the information campaigns, financing connections for particularly vulnerable families from own funds and subcontracting external experts.

All adjustments are assessed as relevant and correct and are evidence of adaptable project management.

Rating summary of relevance: **very successful (1)**

The project responded to a prevailing core problem of the city of Granada to an appropriate extent and at an appropriate cost with a sensible, three-pronged concept and invested in robust technology appropriate to the context. It adequately considered the needs of the overall population and the executing agency. Various meaningful adaptation measures over the course of the project testify to a dynamic, responsive implementation team. Relevance is rated as very successful, exceeding expectations.

Coherence

5. Internal coherence

German development cooperation has been active in Nicaragua since 1992, focussing on the water supply and sanitation sector. This focus has enabled a positive and continuous development of cooperation as well as stability in the projects and with the project partners.

Firstly, the project benefited from the experience of the project "Drinking water supply and wastewater disposal in the cities of *Matagalpa, Jinotega and Corinto* (MaJiCo)" (BMZ No. 1994 66 418), particularly in the areas of technical and institutional strengthening of ENACAL and the decentralisation of operational management. Secondly, the findings from the project "Rehabilitation of Lake Managua / Wastewater Treatment Plant Component" (BMZ No. 1999 66 706²) contributed to the selection of suitable materials and equipment to extend the service life of the plants and reduce future operating costs. In addition, the successful public-private operating model with a private operator was expanded and cooperation with the consultant was continued so that the institutions involved could draw on existing experience, contacts and communication channels. The third project, "Promotion of local development and good governance", which was running in Nicaragua at the time of the project appraisal via the FISE municipal development fund and was responsible for rural water supply, did not show any overlaps.

Synergies and co-benefits were created as part of a project with German technical cooperation (TC) to increase the efficiency of drinking water supply and wastewater disposal from 2015 to 2023 (*Programa Asistencia Técnica en Agua y Saneamiento*, PROATAS). Similar to the project supported via German financial cooperation (FC), PROATAS invested nationwide, but later, in the institutional strengthening of the ENACAL headquarters and its delegations as well as in the establishment of a geo-referenced information and customer cadastre system. These systems enabled timely customer analyses, invoicing, indicator monitoring and

² Evaluated in 2018 with an overall rating of 2.

the identification of water leaks by ENACAL. Both TC investments had a positive impact on the day-to-day administration of DDG. The exchange between TC and FC was limited to the usual formats of German cooperation, but was appropriate given the limited overlap in time and space. The DC project, under the coordination of TC, concentrated only on a minimal exchange on the reports to be written. Nevertheless, the partner considers the projects to be complementary, whereby the overlap in terms of content is considered appropriate without duplication.

From 2019 to 2023, the PTB project "Promotion of quality assurance services for the drinking water and wastewater sector" invested in particular in laboratories, a national metrology laboratory (LANAMET), strengthening the capacity of the national accreditation body ONA (*Oficina Nacional de Acreditación*) and the development of wastewater standards. Cooperation was minimal as the project was assigned to another ministry (MIFIC), started later and was only implemented slowly.

6. External coherence

The project complemented the partner's own efforts in a meaningful way (see Relevance).

One particularly valuable cooperation was the acquisition of around EUR 4.2 million (12% of the final total funding) from Japanese development cooperation funds. The Japanese funds were linked to the already ongoing and fully planned FC project and fully utilised its systems for monitoring, communication and other areas.

It was possible to achieve slight synergies with the "*Programa Integral Sectorial de Agua y Saneamiento*" (PISASH) project, which is active in 19 small towns, without any unnecessary overlaps. In Granada, the project was particularly visible through the presence of the regional centres CRAI (*Centros Regionales de Atención Inmediata*). These centres provide special equipment for the repair of wastewater and drinking water systems and have a team for the maintenance and repair of domestic water meters. These measures are also important for the (electromechanical) sustainability of this FC project, as the CRAIs also have the expertise and tools for the maintenance and repair of medium-voltage systems, which ENACAL otherwise only has in the capital Managua.

Due to the clear geographical delimitation of the project, its successful integration into the ENACAL strategy and the limited presence of other donors in this sector, no further cooperation or utilisation of additional synergies was to be expected.

Rating summary of coherence: **successful (2)**

The sensible intermeshing and utilisation of synergies in the sector was primarily ensured by bundling all donor-funded activities at ENACAL. The project was the only one focussing on Granada, but the DDG also benefited from other projects. Windfall effects for and via other projects due to the institutional strengthening of ENACAL, which was part of several projects, are also plausible. Building on the long-standing cooperation with TC and FC in the sector was conducive to success. Overall, coherence is rated as good, in line with expectations.

Effectiveness

7. Achievement of objectives

The objective at the outcome level was to contribute to a continuous, ecologically sound and economically efficient water supply and wastewater disposal system in the city of Granada.

The following indicators were used to measure the outcome objective. The values submitted by the DDG at the time of the evaluation deviate in part from the values stated in the AK (project closure report). The reasons for this could not be fully clarified, but the deviations are minor and not decisive for the evaluation. Both data bases are presented for reasons of transparency:

Indicator	Status at time of review	Target value at EPE (review)	Actual value at PCR	Actual value at EPE
(1) Proportion of households with a connection to the WS that have a continuous supply	70 % (2006, AK and DDG)	90 % (2021)	90 % (AK) 91 % (DDG)	92 % (DDG) Target value achieved
(2a) Proportion of households with WS that have access to the WD network	20 % (2006, AK and DDG)	60 % (2021, AK) 65 % (2021, DDG)	66 % (AK) 67 % (DDG)	71 % (DDG) Target value achieved
(2b) Proportion of households with WS that have access to the WD grid (2a) and	23 % (2012, DDG)	60 % (2021, AK) 65 % (2021, DDG)	66 % (AK) 65 % (DDG)	66 % (DDG) Target value achieved

are connected to the WD grid				
(3) Technical and non-technical (water) losses in the distribution network	65 % (2006, AK) 70 % (2006, DDG)	<35 % (2023, AK and DDG)	50 % (AK) 54 % (DDG)	39 % (DDG) Target value not achieved
(4) Lifting efficiency	65 % (2006, DDG)	85 % (2023, AK and DDG)	82 % (AK) 90 % (DDG)	107 % (DDG) Target value achieved
(5) Coverage ratio of operating costs at ENACAL	65 % (2011)	100 % (2023, AK and DDG)	103 % (AK) 117 % (DDG)	105 % (DDG) Target value achieved

Table 2: Outcome target achievement.

Note: All values relate to the city of Granada with the exception of indicator 5, which relates to the entire Granada delegation, as the operating costs are not available for individual branches. The actual values as at December of the respective year are given for indicators 1-3 and annual average values for indicators 4-6. The indicators were expanded during the course of the project to include additional management indicators and were marginally adjusted as part of the EPE. A resulting indicator 2c measured the proportion of households with a connection to the water supply that are connected to the WD grid; according to the DDG 2024, this was 46%, but was not part of the regular ENACAL-KfW monitoring and is not considered further here to reduce complexity.

When interpreting the indicators, it must be noted that i. as is typical for operational data, all data was collected and provided by ENACAL and therefore does not come from independent sources, ii. population growth (positive in this case) has a partial influence (negative in this case) on the percentage of indicator achievement³, and iii. values for some indicators are not available at the time of the project appraisal, as these were only included in the project monitoring at a later date.

Water supply (indicator 1): the connection rate to a continuous water supply (among households with a connection) rose from 70% to 92% between 2006 and 2024.⁴ The target value of 90% was also already met for AK. "Continuity" of water supply is defined as a supply of 19 to 24 hours per day; however, pressure measurements and the survey of the population suggest that all households at this level actually have a continuous 24-hour supply service. The observed increase also took place in peri-urban areas and therefore benefited poor sections of the population as expected (even if not the very poorest, uncontrolled poor neighbourhoods). Overall, the indicator values increased over time and have stagnated since 2020/21, which may be due to the now necessary expansion of connections in low-income households/areas.

The drinking water supply works according to the following principle: drinking water is extracted from three well fields (*El Escudo*, *Quinta Ena* and *Las Carolinas*) and 2 individual wells (*Hormigón* and *La Colonia*) and pumped directly from there to a primary distribution ring in the city or to the *El Capullo* equalisation tank. The water is disinfected directly at the wells as well as at the *El Capullo* reservoir. The equalisation tank is filled during hours of low consumption and can feed additional water into the network during hours of high water consumption. The water is distributed from the primary distribution network to 20 consumption zones. Thanks to sectorisation⁵, these 20 zones are isolated from each other and the incoming water volume is measured at the incoming points. This can later be compared with the billed water volumes of the connections, which also allows the losses in the zone to be determined and rectified. The pressure in the zones closer to the lake is regulated with pressure reducers.

In general, both ENACAL and MINSa have confirmed that the drinking water quality is good and fulfils both national requirements and WHO standards. The MINSa only criticised the fact that the chlorine content in the drinking water can exceed the limit of 2 mg/l, which greatly changes the taste and also the smell of the water. This was also mentioned several times by the population surveyed in one zone (sector 1). Technically, the high chlorine content at certain points can possibly be explained by the location of the affected sector in the immediate vicinity of the well where chlorination takes place – once and for the entire network. A persistently high chlorine content in drinking water can lead to irritation of the throat and stomach or nausea.

³ According to the city administration, the number of households in the city of Granada, for example, rose from 19,965 to 22,819 between 2014 and 2024. An increase in existing households can affect the percentage success in connecting new households.

⁴ According to interviewees, the supply in the remaining 8 % runs from 2 a.m. to 2 p.m.

⁵ Sectorisation was implemented within 8 months. The ring network is based on the "production-distribution" concept, which enables supply from various points on the ring.

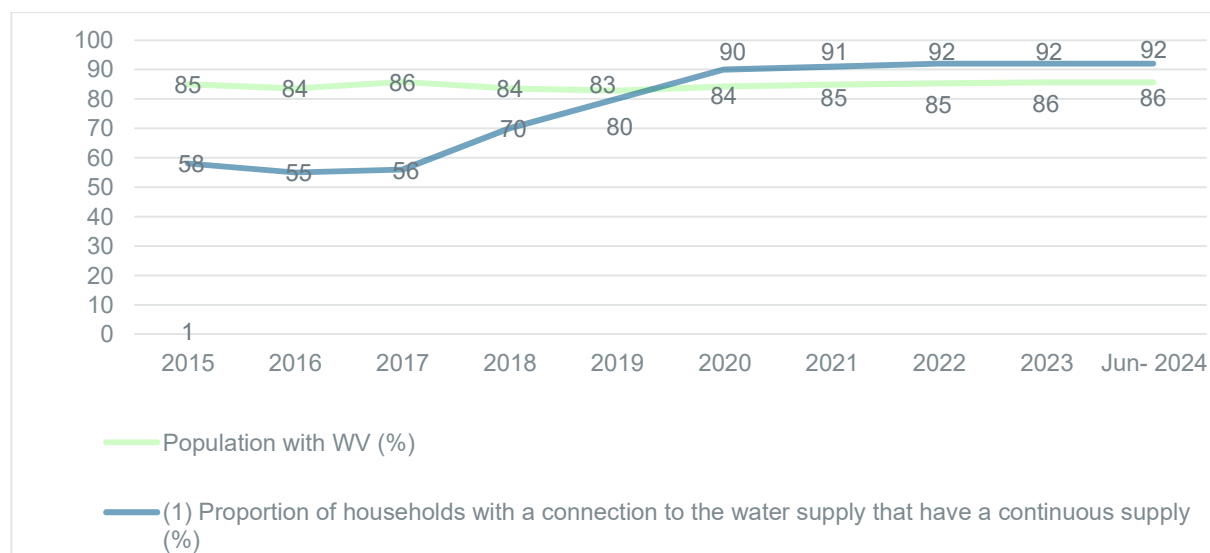


Figure 3: Access and continuity of water supply

Source: Own illustration using the values provided by the DDG in 2024.

Wastewater disposal (indicator 2a - 2b): Figure 4 shows that indicators of access and connection to the WD network rose sharply between 2015 and 2017 and have continued to rise by around one percentage point per year since then. It shows that in 2024, 71% of households with water supply access also had access to the WD network, i.e. a connection shaft was generally installed on their doorstep. The expansion targets of the project (indicator 2a: target value 65%) were therefore achieved or exceeded. By mid-2024, 66% of households with a connection option had actually been connected via in-house pipes (indicator 2b, target value 60%); the average connection rate in the project neighbourhoods is higher (85%).

According to interviewees, the connection rate is particularly low in the (high-income) historic centre, where homeowners (some of whom live abroad) do not want to tear up the colonial houses (tiles) and instead stick to septic tanks⁶. During the EPE, however, households were also seen in peripheral centres that were not connected.

Wastewater disposal and treatment works according to the following principle: The sewer network is roughly divided into 3 catchment areas. The largest covers 2/3 of the city and is located higher than the sewage treatment plant and is drained directly to the sewage treatment plant by gravity. The remaining two catchment areas, *Centro Historico* and *Villa Sandino*, are located on the lake and each pump into the main collector of the first catchment area via a pumping station and thus reach the sewage treatment plant. The treatment plant first consists of mechanical pre-treatment with a screen, grit chamber and fine screen. The wastewater is then channelled through an UASB reactor, via two optional clarification ponds to two fining ponds. From there, some of the wastewater is reused in agriculture and the rest is discharged into Lake Nicaragua.

Following the extension of the 2020 expansion target, the wastewater treatment plant has an average capacity of 14,700 m³/d or 110,000 PE (original capacity: 9500 m³/d or 69,000 PE). The average capacity utilisation of the plant in 2023 was around 9200 m³/d or approx. 60% of the hydraulic capacity utilisation and around 70% of the dirty load capacity utilisation. Hydraulic utilisation has therefore increased by 36% since 2016. The measured discharge values show a very stable reduction in organic load of around 90 %, which is typical for the selected process and the local climate. The amount of gas produced in the UASB reactor is also a clear indicator that the reactor is working well. The pollution levels measured in the outlet were therefore below the agreed limits permitted in Nicaragua. The wastewater treatment plant is not designed for the degradation of nitrogen and phosphorus, which is not required by the standard. This is a favourable factor for reuse in agriculture.

⁶ ENACAL - alongside private providers - is responsible for emptying and checking the values of the septic tanks.

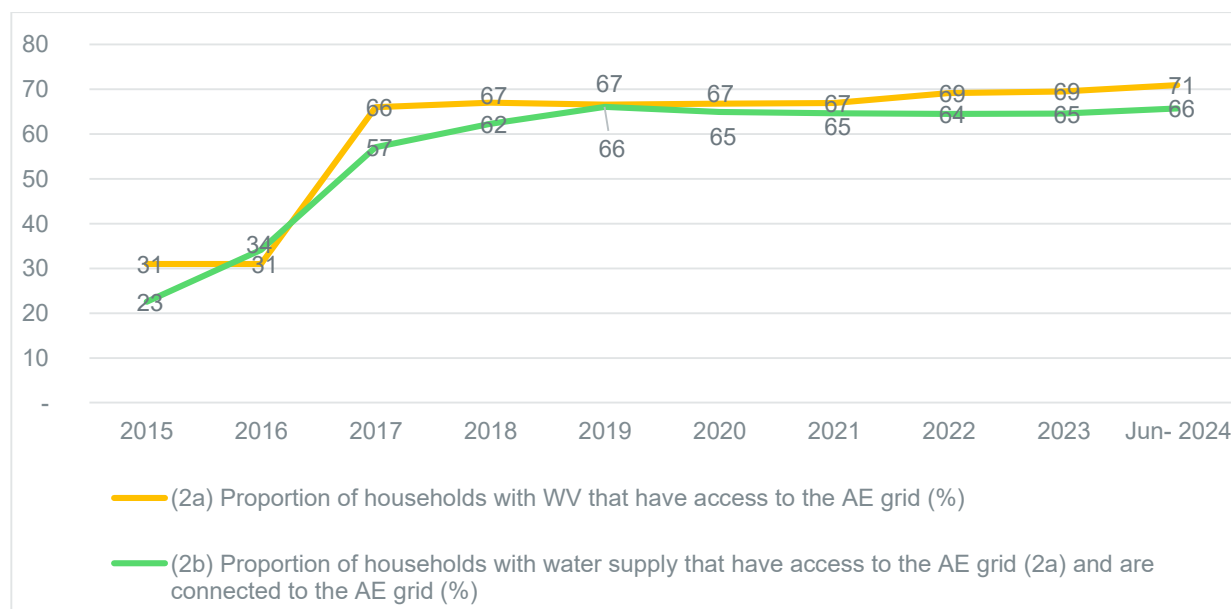


Figure 4: Access and connection to the wastewater disposal system.
Source: own illustration using the values provided by the DDG in 2024.

Commercial and operational targets (indicator 3-5): Figure 5 shows (in grey) **the technical and non-technical water losses** in the network (non-revenue water, NRW). The losses result from (invisible) leaks, illegal connections and interfaces between sectors. The target of reducing water losses to below 35 % in 2021 was appropriate due to the high starting value of 65 % in 2006 at the ambition level, although a level of 25 % should be aimed for in similar country contexts with sufficient funding in the medium term. Figure 5 shows that the NRW decreased continuously and significantly, but at 39% at the time of the EPE was still 4 percentage points above the target value and was generally still clearly too high for a city like Granada.

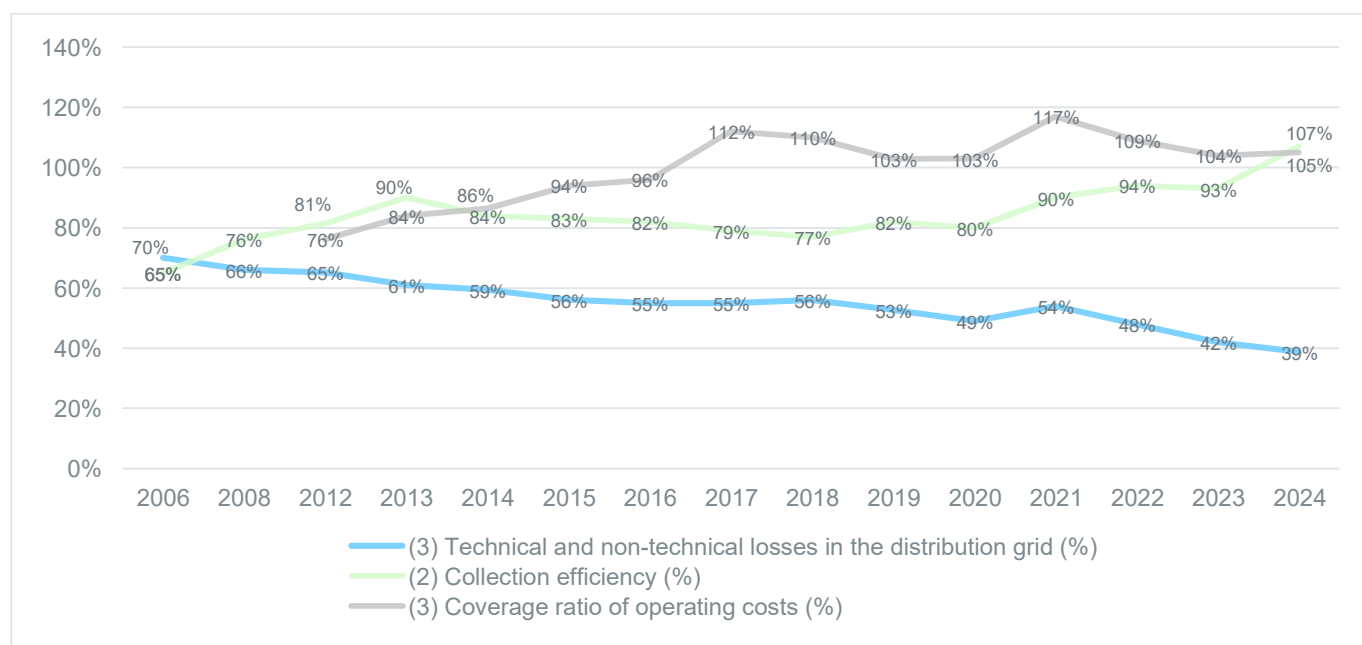


Figure 4: Commercial and operational indicators.
Source: Own illustration.

It should be noted that the data is subject to a high degree of uncertainty, as the measured consumption only corresponds to 30% of total production. All other values are based on estimates (see Table 1). The proportion of consumption without a domestic meter, for example, is estimated to be at a similar level to measured consumption. It can therefore be assumed that the real NRW level is even higher.

In addition, the NRW values presented here do not correspond to the NRW values resulting from the calculation of the produced water volume minus the billed water volume at the level of all 20 relevant individual sectors. These are significantly higher (2021: 66%, 2022: 54%, 2023: 41%, June 2024: 46%), a rough extrapolation for the sectors supported by the project shows NRW of 46% for 2024. These differences could not be finally clarified as part of the EPE. The unsatisfactory clarification of the data differences leaves doubts regarding the comprehensive overview of the diverse data situation on site.

#	Consumption in m ³ /month	Dec-13	Dec-20	Dec-21	Dec-23	Note
(1)	=02+09 Feed in quantity	951.487	907.612	937.502	938.670	
(2)	=03+06					
(3)	=04+05					
(4)	-					
(5)	-					
(6)	=07+08					
(7)	-					
(8)	-					
(9)	=10+14					
(10)	=11+12+13					
(11)	-					
(12)	-					
(13)	-					
(14)	=15+16+17					
(15)	-					
(16)	-					
(17)	-					
(18)	=04+05 Billed water volume	361.294	448.154	497.941	535.442	
(19)	=01-18 Unbilled water volume	590.193	459.458	439.561	403.228	
(20)	=19/01 % of water volume not billed	62%	51%	47%	43%	
(21)	=04+06+19 Measured water volume	192.046	263.097	282.835	271.169	
(22)	=21/01 % of measured water volume as a percentage of total volume	20%	29%	30%	29%	

Table 3: Calculation of non-revenue water.

Source: Own illustration.

Figure 5 shows that collection efficiency rose from 65% in 2006 to 107% in 2024. The target value of 92% was therefore exceeded. The collection efficiency reflects ENACAL's success in collecting invoices. The value above 100% shows that overdue invoices from the past have been settled, but these are still high: in 2023, 84% of outstanding invoice amounts were from previous years, 89% of which were already time-barred. According to the implementation consultant, the total payment arrears in 2020 averaged 12 outstanding monthly invoices per active user and residents encountered at EPE appeared to have lost track of the invoices that had been piling up for years and had no payment options. According to DDG, large consumers in particular are incentivised to pay outstanding bills in order to increase collection efficiency. This makes sense, as they are expected to consume more on the one hand and have higher tariffs and ability to pay on the other.

The applicable index tariffs in Granada are graduated according to consumption and user type (subsidised, domestic, institutional and special tariffs for pensioners and single parents) to take account of different needs and purchasing power and are based on the national approach to tariff setting. ENACAL officially submits a tariff proposal for the next five years to the national water authority (ANA), which analyses and approves it. However, the actual influence and control function in this process are questionable; the tariff proposals in recent years have always been approved. Although required by law, the tariffs have not been sufficiently adjusted to rising electricity costs and inflation over the years. In the course of the project, frequent reference was made to the inadequate water and sewage tariffs and an adjustment of the tariffs of the ANA tariff plans was stipulated as a disbursement condition in order to gradually increase full cost recovery through tariff revenues. At the time of the EPE, the tariffs of ENACAL were also lower than those of private providers and were lower than the tariffs in Matagalpa and Jinotega, the former FC locations, which are known for their high profitability. However, the tariff information available as part of the EPE also shows that the tariffs in Granada were increased by between 35 % and 88 % between 2013 and 2021, depending on consumption, user type and for water and wastewater.

Figure 5 also shows the development of DDG's operating cost coverage. These figures relate to the entire department, not just the city of Granada. The coverage ratio rose until 2017 and has fluctuated at a high level since then. The city's cost-effective (relatively energy-efficient) supply and treatment system certainly helps here. The political unrest in 2018 and the Covid-19 pandemic in 2020/21 were mentioned in discussions as difficult years due to rising costs/decreasing payment discipline and mobility (i.e. payment on site at ENACAL) of customers.

8. Contribution to the achievement of objectives

The project generally made a plausible, causal contribution to the changes in the sector described above, as it intervened intensively, locally and in plausible connection with the indicators in the city. In addition, no other major investment measures took place in the water sector in Granada during the same period.

Water supply (indicator 1): In the area of rehabilitating and expanding the water supply, the project largely achieved and, in some cases, exceeded its output targets. At the time of the final inspection, only 50% of the 22 distribution districts had been set up and rehabilitated, but the installation rate of domestic water meters, for example, had been increased to 87%. At the time of the EPE, the sectors were fully installed. The outputs realised included in particular

- i. Rehabilitation of existing wells, new construction of the *El Capulín 2* well, construction and equipping of the *Las Carolinas* deep well and establishment of a protection zone around the well, well supply lines
- ii. Rehabilitation of four metal storage tanks
- iii. Sectorisation of the network (construction of a main pipeline network in ring form and creation of 20 hydraulic sectors within a ring), establishment of pressure zones, automation of pump operation, rehabilitation and replacement of approx. 64 km of distribution pipes, installation of 5,320 house connections and 11,200 house water meters (of which 2,166 were financed from the executing agency's own funds).

The outputs described were intended to improve water distribution, ensure water quality and reduce physical water losses in the system and in households. This resulted in a self-sufficient water supply, i.e. the city is able to cover its water requirements independently. For end users, this meant higher supply pressure, continuous service in more areas of the city and medium-term protection of water quality. Residents met during EPE in various parts of the city confirmed the improvement in the quality of supply (24-hour supply) and emphasised the importance of this for their quality of life.

The ENACAL laboratory in Granada is fully equipped and has sufficient consumables to ensure water quality. The laboratory specialises in the disinfection of drinking water using chlorine gas. Analyses are carried out daily at various points in the supply network to check both the bacterial load and the chlorine content. In addition, a comprehensive physical-chemical analysis of the drinking water is carried out quarterly. MINSA also carries out monthly bacteriological analyses at 24 locations (see Granada map, relevance), both at wells and in the supply network, and physico-chemical analyses twice a year. The chlorine content of the drinking water is also checked twice a week. Two bacteriological tests were carried out as part of the EPE using a test kit. Neither test detected any traces of bacteriological contamination.

The establishment of the protection zone around the *Las Carolinas 1* well, which is being promoted by the project and was not completed until mid-2024, is intended to ensure water quality in the future. The establishment of the zone is very welcome. However, the protective measures for zone 3 are very weak: practically any form of land use is permitted and houses with latrines or septic tanks can be approved, which can lead to bacteriological contamination of the well.⁷ In addition, compliance with the protection zone must actually be implemented in practice by the municipality and monitored by ANA. Currently, the pressure on the zone is low (there is one farmer in the area of influence), so it is a preventive measure to protect against future forms of utilisation, such as a probable expansion of the city. The establishment of further protection zones around other wells is necessary.

The studies financed by the project to monitor the groundwater quality in the catchment areas of well fields, a groundwater study on the potential of new well fields and a study on the establishment of a protection zone were expected to contribute to the water quality assurance described above.

Sewage disposal (indicator 2a - 2c): The construction work on the sewerage network was costly due to the narrow streets, colonial houses and sometimes very deep trenches. In the area around the market, construction work was postponed until night to protect business life. The construction of the *Centro Historico* pumping station proved to be particularly difficult, as the collectors arrive there at a depth of over 5 metres and the structure had to be built entirely with groundwater in place.

⁷ The protected area consists of four zones. **Zone 1** has 400 m² around the well, where no construction/activity is permitted. **Zone 2** is approx. 10 ha in size. It prohibits the establishment of monocultures, the use of agrochemicals, livestock farming, the construction of petrol stations, industries and human settlements, the disposal of solid and liquid waste and the construction of latrines and boreholes without the approval of the National Water Authority (ANA). **Zone 3** is around 18 km² in size. Existing cropland and intensive livestock farming must be monitored and regulated, and authorised wastewater treatment systems are required in the absence of a sewage network. Industries require the appropriate permits for wastewater disposal. The final disposal of solid waste must be regulated by competent authorities and tree felling is prohibited. All economic and social activities are permitted in **Zone 4**, which is around 8 km² in size, as long as they take into account the protection of water resources. Good agricultural practices and appropriate waste management are encouraged, while deforestation is prohibited to protect vegetation, soils and groundwater recharge.

However, the planned outputs for the rehabilitation and expansion of wastewater collection, drainage and disposal were largely achieved. These include in particular

- i. Expansion of the wastewater network with over 57 km of collectors and 6,815 connection chambers, 1,530 domestic connections for the low-income population (from own funds, see above)
- ii. Rehabilitation of existing pond treatment plant, new construction of UASB reactors and clarification ponds, new construction and rehabilitation of a total of three pumping stations⁸ and pressure pipes, installation of an emergency power generator at the wastewater treatment plant, laboratory equipment at the treatment plant.

The full contribution of these outputs to the change in the sector described above and to the achievement of objectives in the area of network expansion and treatment is plausible and direct. At the time of the project appraisal, the sewage disposal system only covered the central city area, with around 20% of an inhabited area of 760 hectares. According to the final inspection, coverage of around 73% of the inhabited area was achieved during the project term. The increase to 71% is substantial given the very low access rate of 23% in 2012.

In order to increase the connection rate, ENACAL also used its own funds to finance the internal connections for a total of around 1,530 low-income households. This included the installation of pipes connecting the sanitary facilities to the connection shaft. The subsidies were provided in low-income peri-urban areas with small houses and inadequate infrastructure, particularly near the lake. Interviewees reported a "socio-economic study" of the households at the beginning of the project, but the interviewees responsible at the time were unable to name the exact criteria for selecting the low-income households and the study could not be located at the time of the EPE⁹. In one neighbourhood visited during the EPE, both visibly low-income households that received the subsidies and those that did not were encountered; the selection criteria were also unclear to the households concerned. Although this lack of communication can lead to misunderstandings and a sub-optimal selection of households, the poverty impact of the project is not strongly impaired due to the fact that the peri-urban areas are clearly low-income. Only a few households refused support due to a lack of interest ("culture of sanitation").

In addition, the involvement of the operating company as part of a public-private operator model was strongly promoted by the project and had a clear, positive influence on the O&M of the facilities (see Sustainability).

Commercial and operational objectives (indicator 3-5): The outputs of this project component were largely achieved. These include in particular

- i. Development and monitoring of an action plan to achieve the commercial and operational/technical project objectives
- ii. Training and further training of the selected DDG staff
- iii. Assumption of costs for auditors, infrastructure measures (office, workshop, warehouse), equipment (tools, vehicles, materials), publications and tenders for the well monitoring programme
- iv. Comprehensive updating of the customer register
- v. Definition of organisational structures for the DDG

The outputs serve directly or indirectly to reduce NRW and/or increase collection efficiency and/or operating cost recovery. To increase collection efficiency, ENACAL updated the customer register, among other things, in order to be able to issue invoices promptly and report overdue payments promptly, as well as to identify incorrect information using photos (e.g. entry of a company as an individual customer). The formulation of action plans and training measures served, among other things, to cover operating costs. In addition, the rehabilitation of the WS/WD systems and their sectorisation naturally contribute to reducing NRW. In addition, the project has since contracted external experts to identify "hidden leaks".

Overarching, FC advocated a strong decentralisation of the operator model in order to replicate positive experiences with an autonomous management model in the predecessor project MaJiCo in the cities of Matagalpa, Jinotega and Corinto. Yet, the current government advocated a centralised model without decentralised autonomies and national water tariffs from 2007 onwards. Finally, a "mixed model" by an external consultant was perceived positively by both partners. This can be seen as a successful compromise.

At the time of the EPE, ENACAL Granada is more deconcentrated than at the time of the project appraisal. DDG is responsible for administrative, operational and commercial activities relating to the Granada department (e.g. repairing leaks, customer cadastre maintenance, customer support, invoicing). It also manages the CRAI. It has around 80 employees in total, including 16

⁸ The concept included the rehabilitation of the existing pumping stations "Villa Sandino" and "Santa Emilia" as well as the construction of a new pumping station called "Centro Histórico".

⁹ According to ENACAL's 2019 connectivity concept, the following criteria applied: a) households with an income of less than C\$ 3,000 córdobas per month, b) single mothers with 2 or more children under 16 years of age, c) households caring for the elderly or people over 60 years of age without assistance, d) homes with physically or mentally disabled people, e) homes in poor condition.

people for administrative, financial and operational activities and 64 people for work in the field and in workshops. In general, however, ENACAL is still highly centralised.

Public relations campaign (no indicator): With the support of the project, ENACAL initiated a permanent public relations campaign to inform the population in Granada about the planned activities and connection options as well as the benefits and proper use of water supply and wastewater treatment systems. This campaign will continue with home visits, the distribution of flyers, school campaigns and radio adverts.

During the EPE, the residents encountered were generally pleased with the project activities and satisfied with DDG's customer service. However, most of the randomly selected respondents (particularly in urban sectors 1 and 2) could not remember meeting social promoters or receiving information about the project; some of the construction work began without prior notice, and house connections were also laid directly. In addition, there was a general lack of understanding among the population for the project and the selection criteria for state support, although this did not trigger any major dissatisfaction. In urban sectors 13 and 18, the activities and social promoters were better known. However, ENACAL employees, including at local level, repeatedly described the public relations work as a great success and attributed the increased connection figures to this.

Institutional strengthening (no indicator provided): During project implementation, ENACAL benefited considerably from the impetus provided by the project, which led to several positive developments: i.) more decentralised structures and a new division of labour with the DDG, ii.) increased expertise in wastewater management and initial positive experiences with UASB reactors, iii.) the continuous implementation of publicity campaigns and the financing of connections in particularly low-income households to increase connection rates, iv.) a more systematic and digitalised approach to NRW, which promoted the pursuit of cost recovery within the delegations, and v.) improved customer service thanks to an updated customer register. All of these factors can plausibly have an impact on other departments at ENACAL headquarters or have already done so to some extent.

Only a few internal and external project factors have made implementation more difficult: limited financial resources at ENACAL, delays and interruptions in construction work due to the colonial buildings and complaints from residents, economic and social restrictions in 2018 and 2021, resistance to connection to the sewage network in the city centre and low purchasing power in certain neighbourhoods.

9. Quality of implementation

The cooperation between the ENACAL head office, the DDG, the implementation and management consultant and FC was intensive and took place via formal and informal communication channels. The feedback on the cooperation and implementation quality was consistently positive. The ENACAL head office was described as a responsive and committed implementation unit, the ENACAL president as a constant and knowledgeable leader. The committed management of the DDG played a decisive role in the day-to-day business in Granada. Management at FC level was perceived as solution-orientated, which is also thanks to the well-networked local representation. The half-yearly follow-up of the indicators by FC contributed to increasing success and anchored the issue of sustainability at ENACAL by covering operating costs. The consultant's staff were regarded as active and respected key people in the project, which is also due to their long-standing presence in Granada. The cooperation with the private operator was also decisive for the technical sustainability of the investments. During the EPE, the positive impressions of the implementation quality were confirmed across all stakeholders, with the exception of the significantly exceeded schedule. In addition, the city administration of the city of Granada played a central role, and here too the cooperation was described as predominantly positive, apart from a few discussions. For example, conflicts with shop owners in the historic centre were resolved by postponing the work until night-time.

The Ministry of Health (*Ministerio de Salud*, MINSa) had regulatory and normative functions in relation to water quality compliance, including taking and analysing water samples in the water network and in the lake. In some cases, it also collaborated in public information campaigns for the population. Another regulatory unit was the Ministry of the Environment (*Ministerio de Recursos Naturales y Ambientales*, MARENA), which was only involved at the beginning of the project by commissioning an environmental impact assessment.

The most formally important regulator in the market is the National Water Authority (*Autoridad Nacional del Agua*, ANA)¹⁰, which was founded in 2010 and has a variety of tasks¹¹. The staff (98 people, as of 08/2024) is highly qualified. However, its regulatory impact in terms of tariffs, quality and efficiency appears to be limited, as its competences in some areas are only restricted to the 26 private water suppliers operating in the country, which means that the largest supplier, ENACAL, is not affected. Quality controls, service design and tariffs are largely determined by ENACAL independently of ANA.

¹⁰ In 2020, the ANA absorbed the previously independent Institute for Aqueducts and Sanitary Sewage Systems (Instituto Nicaragüense de Acueductos y Alcantarillado Sanitario).

¹¹ This includes i.) Authorisation of standards and processes of water suppliers and sanitation providers, ii.) Regulation and auditing of water tariffs, iii.) Generation and administration of a public register of water and service providers, iv.) Development and implementation of a water resources information system, v.) Development of a national water resources plan.

10. Unintended effects (positive or negative)

By strengthening private sector structures in O&M of wastewater treatment plants and pumping stations, improving operational efficiency in Granada with a stronger focus on reducing NRW and increasing collection efficiency, the project has made a positive contribution to ENACAL's financial situation.

Negative, unintended (difficult to avoid) effects were expressed in the temporary dissatisfaction of residents as well as hotel and business people, particularly in the historic centre, due to the extensive road works to install the wide sewage pipes. The concerns related to both the disruption to businesses and the integrity of the historic buildings and streets. To resolve these issues, the work was started at 4 a.m. in consultation with the city council, restructured and carried out with the utmost care. No residual dissatisfaction was noted during the EPE.

Rating summary of effectiveness: **successful (3)**

The project achieved and partially exceeded the objectives at output and outcome level. The project can be expected to have a spillover effect on other cities in the country through the executing agency ENACAL thanks to the strengthening of personnel and the high level of learning experience of the executing agency, particularly in the wastewater sector. However, difficulties in increasing connection rates and collecting bills, as well as in measuring and reducing unbilled water, remain and can only be overcome thanks to the technically cost-efficient and robust water supply and wastewater collection system operated by DDG. The data is partly inconsistent or not fully traceable. Due to the high NRW level, the project is rated as partially successful: it is slightly below expectations, but the positive results dominate

Efficiency

11. Production efficiency

The costs of the project totalled EUR 34.7 million at the time of the final inspection. Of this, EUR 27.2 million came from BMZ funds (78%), EUR 1.4 million from the Nicaraguan Ministry of Finance (4%), EUR 1.9 million from the executing agency ENACAL's own funds (6%) and EUR 4.2 million from Japanese counterpart funds (12%). The funds from ENACAL and the Nicaraguan Ministry of Finance were mainly channelled into water supply (WS) and sanitation (WD), while the Japanese counterpart funds were invested in WD. The project also benefited from increases in the exchange rate between the dollar and the euro in favour of the euro.

The BMZ funds consisted of a grant of EUR 12.92 million agreed in 2006, of which EUR 0.9 million was earmarked for training and further education purposes (A+F). These funds were increased by a loan of EUR 4.5 million in 2012 and a further loan of EUR 10.0 million in 2015 to cover increased costs and rehabilitation requirements.

Figure 6 shows (in grey) the financing provided by the various donors at the end of the project, with FC providing the largest amount. The cost development over time (blue-green) illustrates that the total cost estimate increased several times and that the costs estimated in the feasibility study more than doubled (with a simultaneous increase in investments). The cost increase related in particular to the infrastructure of the WD and the consultancy services. At 47%, the WD was the most costly component, followed by investments in the WS (31%), consultancy services (15%) and the accompanying funds for institutional strengthening.

The increased total costs are due to necessary extensions to the project as a result of an underestimated need for rehabilitation during the project appraisal. Accordingly, the measures were expanded several times between the project appraisal and final inspection, so that the increased costs are also offset by increased outputs¹²: in particular, the construction of main and secondary collectors of the WD collector network was massively expanded in the area of sewage disposal (+304%). Severe delays also meant that the tenders took place at times when economic activity in the construction sector was on the rise (according to the AK, an increase of 18.4% from 2010 to 2011 and 32% from 2011 to 2023), which increased the tender prices for all supply and construction services. In addition, construction companies introduced flat-rate risk premiums on the direct and indirect costs of working with the public sector.

According to the AK, the specific investment costs (based on the 2020 expansion horizon and the connected population) of EUR 340 per inhabitant were 2.4% higher than the estimates of the supplementary appraisal in 2010 (EUR 332 per inhabitant) and 58.1% higher than the estimates at the PA in 2006 (EUR 215 per inhabitant).

Despite the high increases, the costs are considered reasonable in relation to the outputs provided and in view of the price increases in the international comparison. The actual share of consulting services for construction planning and construction

¹² WS house connections: +13%, main lines WS distribution network: -5%, WS distribution lines: +22%, WS house connections: +36%, WD connections: +6%, main and secondary collectors: +304%, connection lines: +390%, connection shafts: -47%, domestic connections: -78%

supervision of 15% of the total costs is considered favourable in view of the scope, quality and duration. The technology implemented is cost-effective, adapted to the local conditions, environmentally friendly and economical. Even from today's perspective, there would not have been a more cost-effective alternative. In 2021, the total operating costs of the DDG reported by the project executing agency were USD 0.29/m³ for water and USD 0.22/m³ for wastewater. This compares favourably with other cities in the region.

The efficiency of the project is impaired by its long duration. The project was appraised in 2006, but actual implementation only began in April 2008 and ended with the final inspection in May 2021, meaning that the project lasted around 13 years instead of the originally planned 4 years. Right from the start, the project was delayed by around two years due to lengthy coordination and approval processes for the invitation to tender for the implementation consultant and the need to repeat various contract awards for supply and construction services¹³. The first construction work began in 05/2012 with lot 2 (sewage treatment plant) in accordance with the contract, and the final work started in 07/2020 with the construction of the "El Capulín 2" well. The construction work took significantly longer than planned due to problems with imports and customs (e.g. main ring mains), a high level of complexity of the construction work due to special features of the city of Granada (narrow streets, colonial buildings, activities in the market area and complaints from residents/business people as well as the occurrence of large-scale festivities).

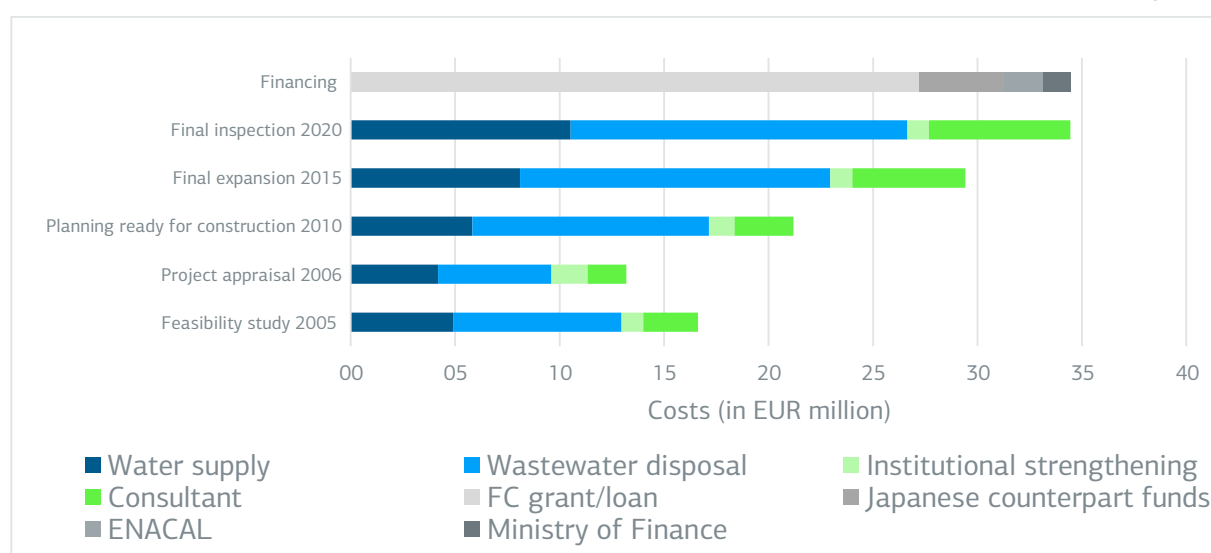


Figure 6: Cost distribution by component and project phase.

Note: Institutional strengthening includes both A+F measures and investments in equipment.

The ENACAL company is loss-making overall. The annual net losses show considerable fluctuations over the years 2015 to 2023, but a clear improvement is visible for the years 2022 and 2023. In 2023, the losses amounted to around 33.0% of total revenue. Overall, losses fell by 31.42% between 2015 and 2023. ENACAL receives reliable government subsidies to cover the operating cost deficit, in particular through discounted energy tariffs, direct subsidies to the ENACAL budget and own contributions to donor-financed projects. According to ENACAL's strategic plan, the company is focussing both on reducing non-revenue water (NRW) and on cutting costs, particularly for electricity and personnel, in order to increase efficiency. For example, ENACAL is planning to build two solar plants and a biogas plant, which should reduce energy costs by 40 %.

The final audit criticised the high number of employees at ENACAL (8 employees per 1,000 connections) compared to other international companies. The high staff turnover and relatively low wages at middle management level compared to the high number of skilled workers were also criticised at EPE. ENACAL frequently encounters criticism of the excessive number of employees from international cooperation partners. According to ENACAL's management, ENACAL is reducing the number of employees by not filling vacant positions, particularly at operational level. However, the number of employees at ENACAL has remained relatively stable since 2018 (reduction from 5,961 in 2018 to 5,762 in 2024), meaning that there is still potential to increase efficiency.

12. Allocation efficiency

¹³ New tenders were necessary due to excessive offers from international companies with high mark-ups for risk protection, which were estimated after the protests throughout the country in 2018. The partial division into individual lots (Lot 1) allowed bids from national companies.

The relationship between inputs and outcomes/impacts is assessed as appropriate overall. The proportion of households with continuous water supply (among households with a water supply) rose from 70% to 92% between 2006 and mid-2024. Access to wastewater disposal (among households with a water supply) increased from 20% to 71% in the same period, while the actual connection to the wastewater network rose from 23% to 66% of this population group. The project had a positive impact on collection efficiency and operating cost recovery. Water losses were roughly halved, but are still too high with at least 39% (see Effectiveness). The overarching impacts of the project are plausible, but can still only be quantified to a very limited extent

Rating summary of efficiency: **successful (2)**

The project efficiency suffers from the slightly limited achievement of the outcome target in the area of water losses (NRW), the time delays and ENACAL's overall loss-making supply operation. Overall, however, the implemented technology is cost-effective, adapted to the local conditions, environmentally friendly and economical. Despite high cost increases, the outputs were produced cost-effectively. Efficiency is still rated as successful.

Impact

13. Overarching developmental changes

The impact-level objective (adjusted as part of the EPE) was a contribution to "improving the health situation of the population of Granada and protecting the ecosystem of *Lake Cocibolca*".

The project invested heavily in tracking outcome indicators, but did not formulate any appropriate impact indicators. The following indicators were used to measure the impact objective/no indicators were specified.

Indicator	Status at time of review	Target value at EPE (re-view)	Actual value at PCR	Actual value at EPE
(1) Annual incidence of waterborne diseases in Granada				
Gastroenteritis	433	Decrease	221	411
Hepatitis A	0	Decrease	3	0
typhoid fever	0	Decrease	0	0
Shigellosis	0	Acceptance	0	0
Amebiasis	0	Acceptance	0	0

Table 4: Impact target achievement.

MINSA provided the EPE with aggregated time series data from 2006 to 2024 from Granada's hospitals on the prevalence of gastroenteritis, hepatitis A, typhoid fever, shigellosis and amebiasis. All of these diseases are mainly transmitted through the consumption of contaminated water or food, e.g. through the presence of faeces from infected people. The latter four diseases only occurred in very rare cases (between 0 and a maximum of 4 per year) and remained largely unchanged between the PP (2006) and EPE (2024); accordingly, no change in the data can be observed at the time of commissioning of the drinking water and wastewater systems. The prevalence of gastroenteritis fluctuates between 221 and 621 annual cases; no clear trend can be recognised here either.

Lake Cocibolca ecosystem: The regeneration capacities of the lake are intact, thanks to its surface area (19th largest lake in the world, see also location map) and the high temperatures vis-à-vis only a few towns and industries in the immediate vicinity. Even at the time of the project appraisal, there were no urgent problems that seriously jeopardised the lake. In the long term, for example due to increased use of the lake as a source of drinking water, a very strong increase in building development, industrialisation and/or agricultural use of the surrounding area, a greater threat to the lake is possible. In particular, the realisation of the long-discussed (but currently unforeseeable) construction of the Nicaragua Canal through the lake would be expected to have a massive negative impact on the ecosystem.

14. Contribution to overarching intended developmental changes

Health impacts are plausible due to the close connection between access to drinking water and wastewater systems and water- and vector-induced diseases, but do not necessarily occur¹⁴. According to the interviewees, positive health effects generally resulted from the wastewater component in particular, and less from the drinking water component.

Theoretically, the project may have had a positive impact on the health situation of the Granada population through several mechanisms: i.) by reducing health risks, ii.) by increasing education and raising awareness of hygiene precautions and iii.) by improving health services thanks to reliable water supply and wastewater disposal in hospitals and health stations.

Reduction of health risks: According to MINSA interviewees, the project causally reduced the incidence of disease in the city. However, the diseases described above were largely absent or stable over the course of the project. Moreover, the data must be interpreted with caution, as: i. a causal attribution of changes in the health situation to the project is not possible due to a lack of counterfactual (what would have happened in the absence of the project), ii.) no data is available from independent actors, iii.) data on other water-induced diseases (general diarrhoeal diseases, cholera, leptospirosis, hepatitis E, giardiasis, cryptosporidiosis or worm infections) or diseases favoured by stagnant water (e.g. dengue) is not available. In addition, the data only covers cases treated in hospitals; however, it is plausible that poor people in particular suffer from these diseases and are not hospitalised and recorded due to the cost of treatment.

ENACAL and MINSA regularly take samples to check the quality of drinking water and wastewater within the drinking water systems and at open water points (see also location map, Effectiveness).¹⁵ According to MINSA data from 2020 to mid-2024, the samples were consistently negative, i.e. limit values were not exceeded. However, MINSA and the population occasionally complain that the chlorine content in drinking water is too high.

The project plausibly avoided negative health impacts (originally unintended in the project appraisal) by identifying the elevated nitrate levels in the *Quinta Ena 2* well and drilling and equipping the *Las Carolinas* well as a replacement; this enabled the spread of nitrate-contaminated drinking water to be stopped at an early stage. According to MINSA, the availability of drinking water also enabled compliance with hygiene measures during the Covid-19 pandemic. At the same time, the pandemic helped to sensitise the population.

Improved health services: According to MINSA interviewees, the project had a positive impact on the quality of health services, particularly at the "Japanese Nicaraguan Friendship Hospital" (*Japan Friendship Hospital - Nicaragua*), which before the project only had an unreliable water supply from a water tank that was limited by power outages. Today, the permanent and high-quality water supply enables a 24-hour service, increased hygiene standards for hospitalised patients and increased the confidence and satisfaction of the population in the facility. Apart from such anecdotal expert reports, this thesis cannot be further verified due to a lack of data.

Hygiene competence/awareness-raising: The project's publicity campaigns emphasised - in their pamphlets, radio reports, talks with social promoters and in schools - the health risks of exposed sewage and raised awareness of the proper use of sewage pipes and strainers (especially in smaller workshops, "deep-frying kitchens" and butcher's shops). However, random home visits revealed that ENACAL customers in some neighbourhoods had not received any such visits/information materials or at least did not remember receiving them. The publicity campaigns were rated by the executing agency as an important success factor of the project and from the EPE's point of view they also make a plausible conceptual contribution to a cleaner environment, but must be implemented regularly in all neighbourhoods. The awareness-raising and educational successes, resulting behavioural changes and, in turn, the resulting effects on health cannot be quantified within the framework of the EPE.

Lake Cocibolca ecosystem: The project has plausibly reduced the discharge of wastewater into the natural environment and the improper use of septic tanks and latrines, thereby reducing the infiltration of wastewater into soils and potentially aquifers. Positive effects on the ecosystem are therefore likely at very limited, localised points, particularly at the two former major dischargers of wastewater into the lake. However, the regeneration capacities of the lake would have been sufficient, as expected, even in the absence of the project. However, prophylactic effects may be conceivable in the long term.

15. Contribution to overarching unintended developmental changes

Waste management: The sewage sludge from the financed sewage treatment plant is largely disposed of at the *La Joya* open waste dump, where it could enter the headwaters and jeopardise agricultural crops in large quantities (e.g. nutrient overload,

¹⁴ Reasons for this can include: lack of hygiene practices, water pollution at home, lack of complementary health measures, infrastructure deficiencies and resulting leaks/spillages/contamination.

¹⁵ Firstly, the MINSA checks almost monthly for the presence of *Vibrio cholerae* silasi at three bridges, four riverbanks and three canals (an average of around 79 samples per year). Secondly and thirdly, it takes an average of 150 bacteriological samples and around 180 samples for chlorine content at 22 locations - schools, health facilities, markets and wells - every year. Fourthly, it carries out 10 physico-chemical samples a year in wells and water tanks.

pollutants, soil acidification). The landfill has long been criticised for its inadequate waste management standards; interviewees gave varying accounts of the current status of the landfill. However, if this continues to be inadequate, the sewage sludge represents a relatively minor problem. Waste disposal in the city of Granada has also improved significantly and is a priority for the city administration; however, the infiltration of waste into stormwater drains and the lake is still visible in some areas of the city. This problem area - in particular a possible threat to the well fields from *La Joya* - was addressed by the project to an appropriate extent, but was also outside its scope.

Tourism and quality of life: Interviewees unanimously emphasised that both the reduction of open sewage and the (geographically and temporally) extended drinking water supply benefit the quality of life of the urban population as well as tourism, and consequently the local economy.¹⁶ Interviewees from the local population often mentioned the positive effect of no longer having to get up at night to collect drinking water or use rainwater tanks (potential breeding grounds for mosquitoes). The project increased the attractiveness of the streets and the lakeshore, which is why, among other things, the *Malecón* promenade was extended and upgraded and the lake is now used by tourists as a bathing resort. While the tourism industry was able to provide an adequate supply of drinking water within the city centre even before the project (probably at higher costs for water tanks to ensure a continuous supply), interviewees reported an increase in hostels in poorer districts on the outskirts of the city and increased sources of income as a result.

Rating summary of impact: **moderately successful (3)**

The evaluation of the overarching developmental impact of the project is only possible to a limited extent due to a lack of quantitative data. The project has plausibly made a (non-measurable) contribution to reducing health risks, improving health care and increasing the city's tourism and economic potential. A substantial effect on the ecosystem of *Lake Cocibolca* is not to be expected. The impact of the project is assessed as limited: it is below expectations, but the positive results dominate.

Sustainability

16. Capacities of beneficiaries and stakeholders

In general, ENACAL's staff have the necessary training and have shown great commitment within the framework of the EPE. A limitation for the DDG is that employees have to fulfil several functions at the same time due to a lack of personnel/financing¹⁷, which restricts them in the performance of their work.

ENACAL has extensive operational experience in the drinking water sector. The facilities visited at EPE were all in good condition. For the maintenance and replacement of domestic water meters, DDG manages a workshop with four employees¹⁸ in Granada. Their work appeared to be well organised, well equipped and routine during the evaluation mission. It should be noted that ENACAL in Granada does not provide sufficient capacity for wastewater network cleaning.¹⁹

In contrast to its extensive experience in the drinking water sector, ENACAL has only limited experience in the waste water sector. The following history emphasises this: After completion of the construction of the sewage treatment plant in Granada, ENACAL took over the O&M of the two pumping stations (*Villa Sandino, Centro Histórico*) and the sewage treatment plant. However, staff turnover was high, the personnel were not sufficiently qualified, some elements no longer functioned properly after a short period of operation (e.g. sand classifier) and some maintenance activities were not carried out (e.g. sludge flushing). At the insistence of KfW, ENACAL transferred the O&M of the plants to a private operator from January 2015 to July 2024. The cooperation followed the cooperation model of the wastewater treatment plant in the capital Managua²⁰, a far more complex plant that the operator has been running successfully since 2002. In the cooperation in Granada, the operator took over the operational management and managed the maintenance and process personnel²¹ still employed by ENACAL on site. Since then, the operator has successfully pursued a preventive maintenance plan in order to minimise corrective maintenance. At the time of the EPE, the wastewater treatment plant was utilising 62% of its hydraulic capacity and the reactors were functioning well despite a higher than expected industrial load of wastewater²², as the pollution load was generally still below the maximum capacity (70%). From the perspective of all interviewees, the public-private cooperation was largely responsible for the very good condition and

¹⁶ The city of Granada is considered the most visited city in the country due to its colonial buildings, its location on the lake with its 360 small islands (isletas) and its proximity to the Mom-bacho volcano nature reserve. According to the city administration, over 60,000 national and international tourists visited the city in Easter week 2024 alone. Thanks to its cultural and natural heritage, the city is currently applying to be recognised as a UNESCO World Heritage Site.

¹⁷ For example, the DDG management is also the sales management; the 'social promoters' are also regularly deployed for customer analyses.

¹⁸ The team replaces domestic water meters if there are complaints from customers or if they are 3-4 years old or older. The team has 1,548 domestic water meters; in the course of the project, they have received 300 new ones, 120 of which are still waiting to be installed. According to the interviewees, there has only been one shortage of domestic water meters so far.

According to ENACAL's president, the company is considering the use of smart domestic water meters in some sectors in the medium term.

¹⁹ ENACAL's wastewater network maintenance and cleaning team consists of a hydraulic vacuum cleaner and 4 people who look after around 90 kilometres of sewerage system. However, with a daily cleaning capacity of 300-400 metres per day, this capacity is not sufficient to ensure sustainable preventive maintenance of the networks (at least 2 cleanings per year, or more frequently in critical areas).

²⁰ The associated operational management contract was concluded as an addendum to the current contract of the private operator in Managua.

²¹ The ENACAL team included an electrician, a mechanic and 2 assistants. At the initiative of the private operator, the former security personnel were also replaced by maintenance personnel, the personnel who had previously rotated between locations were given fixed responsibilities, instructions were replaced by a graphic maintenance plan and the personnel received regular training.

²² Among other things, due to the addition of a chicken butchery, a yuca flour plant and a poultry processing plant.

performance of the plants in Granada. The handover of the private operator's systems to ENACAL took place on 1 July 2024, i.e. shortly before the evaluation mission. ENACAL's maintenance and process staff, formerly managed by the private operator, remained in place, which certainly strengthened the handover and continuation of operating standards. However, the official transition phase only lasted 15 days.

The above-mentioned history raises doubts about ENACAL's capacities for the O&M of the plants in Granada and, accordingly, their sustainability. A "maintenance team"²³ from ENACAL manages the O&M and solves problems with electromechanical parts independently. However, this team is also responsible for other locations (e.g. *Juigalpa* and *Masaya*). Given the increasing number of pumping stations and sewage treatment plants, it would not be surprising if this team is limited in terms of personnel and logistics in its routine work. In addition, the WS/WD systems will require increasing rehabilitation and maintenance as they age. The fact that ENACAL has visibly expanded its previously limited experience in wastewater management in recent years, for example operating similar systems (*Juigalpa* and *Masaya*) independently for 3 and 2 years respectively and taking over systems that are more complicated to operate (*Rivas*) in another city, speaks in favour of continuing the systems successfully. In addition, the systems in Granada are not very complex, and appropriate maintenance and operating plans have been installed. ENACAL also carries out annual audits of O&M to identify and rectify any deficiencies; these audits are carried out by the maintenance team itself. Should O&M continue successfully, ENACAL would have successfully "learnt and copied" from the operator, thereby reducing the costs (previously payable to the operator) for O&M. It is not possible to conclusively estimate the future O&M risk for the wastewater treatment plant and pumping stations as part of the EPE due to the still very short period of operational management by ENACAL.

One sustainability risk in the area of wastewater and drinking water is the repair and procurement of spare parts within ENACAL. Access to spare parts is restricted, the maintenance budget is limited, and compliance with procurement guidelines for rare parts can be lengthy. However, according to ENACAL interviewees, the required parts are available on the market and interchange between different ENACAL plants is sometimes possible. Repairs are first carried out by the teams on site, then by a pump maintenance team and the six CRAI centres, and finally by the ENACAL workshop in Managua. In many cases, this reorganisation enables faster interventions without having to involve the head office in Managua. The transfer of critical spare parts from the stock purchased by the operator for Granada can also be sufficient in the short term. Nevertheless, from the perspective of the evaluation, the greatest sustainability risk is the sufficiently rapid response to repair requirements and the timely procurement of spare parts.

DDG is clearly benefiting from the introduction of the geo-referenced information system SIGIL (*Sistema de Información Geográfica para la Integración de la Logística*) thanks to its systematic recording of customer data and the resulting ability to analyse errors. Tools and processes for collecting charges more efficiently, reducing outstanding payments by increasing willingness to pay, updating and digitising the customer register, modernising consumption measurement and legalising unregistered connections were beneficial for management. The serious, monthly tracking of project indicators by DDG and their follow-up by the head office also clearly supported DDG management in achieving the indicators. There is a risk that this focus on monitoring and target achievement and the interest of the ENACAL head office in the specific values from Granada will diminish after EPE.

As a state-owned company, ENACAL is loss-making overall, but relies on reliable state subsidies (see Efficiency). In contrast, DDG's increased cost recovery is a success, which is partly due to the low-cost systems (low electricity costs due to a flat terrain, only 40% of the collected wastewater is pumped, wastewater treatment consumes hardly any electricity) and significant improvements in the area of management. At the same time, the proportion of NRW is still high and is above the specified target value of 35%, which limits operational efficiency.

17. Contribution to supporting sustainable capacities

The project made a significant contribution to building sustainable capacities both locally at DDG and nationally at headquarters. It was also crucial for the introduction of the public-private operating model, which ensured the proper operation and maintenance of the facilities and led to an indirect, eight-year training project for ENACAL staff at the pumping stations and the treatment plant.

Considerable efforts were made on the project side to reduce water losses in the distribution network. An external consultant was commissioned to systematically identify leaks, illegal connections and cross-connections to older parts of the system and to take appropriate remedial measures. The systematic recording and reporting of water losses in accordance with the IWA (International Water Association) standard enables a quick assessment of current losses and the rapid identification of sectors that require special attention. The reduction in water losses contributed to cost recovery within the DDG.

The commercial and operational instruments and processes established in the DDG were strongly supported by German development cooperation, particularly through this project. Thanks to the project, a culture of regular monitoring based on quantitative

²³ This consists of an engineer, an electrical engineer, an electromechanic, an electrician and 4 assistants.

data also developed: Before the start of the project, none of the indicators used here (see Effectiveness) were tracked. KfW's consistent follow-up with regard to indicators still to be achieved - even beyond the final inspection - as well as ENACAL's high willingness to cooperate contributed significantly to this progress.

The expansion of the sewage network and the operational improvements also led to higher income for ENACAL Granada, as fees are now charged for the collection and treatment of sewage.

18. Durability of impacts over time

The durability of the impacts over time is generally plausible, but strongly dependent on the future O&M of the facilities, the increase in bill payment by customers, an increase in WD connections and a substantial reduction in NRW.

At the same time as the evaluation mission, a municipal ordinance was passed in the city of Granada that stipulates a mandatory connection to the sewage system. The approval of the ordinance was a sensitive process that could not be successfully implemented during the project. In theory, the mandatory connection could significantly and sustainably increase connection rates and revenues; however, the ordinance's actual effect in practice remains to be seen.

The success of the project implementation was strongly driven by the commitment of the ENACAL management, the cooperation with the private operator, the close involvement of KfW and the implementation consultant, as well as the intensive interest and financial and personnel support of the ENACAL centre for the DDG. The withdrawal of individuals and institutions (KfW, consultant) may represent a risk, but this is plausibly minor, as the operation of the installed systems is much less dependent on them.

The establishment of a water protection zone around the *Las Carolinas* well in cooperation with ANA and the city administration, which was promoted by the project, is also intended to protect the project impacts in the long term. The protection zone is important. At the same time, however, other wells must also be protected and land areas and associated protection zones for future wells must be established at an early stage in order to be able to react quickly if a well fails. According to ENACAL's strategy, a national fund is to be set up for well drilling, but this is still pending.

The long-discussed construction of the Nicaragua Canal, which would connect the Atlantic and Pacific Oceans via *Lake Cocibolca*, among others, is currently not foreseeable. However, such construction would be massively invasive for the ecosystem of *Lake Cocibolca*; any protective effects of the project would be cancelled out by such construction. This would also lead to salinisation of the lake and would have far-reaching consequences for the safety of the drinking water supply in southern Nicaragua. The impact on the city of Granada and its population would also certainly be serious.

The following points are relevant for ensuring the impacts over time and the sustainability of the project:

- **Water losses and collection efficiency:** the implementation of projects to reduce water losses and replace water meters as well as the installation of additional water meters would need to be further prioritised in order to increase the efficiency of the system. Measures need to be taken to reduce the far too high number of unpaid bills and to further increase the stagnating collection efficiency.
- **Connection rate:** the development of adequate financing options/subsidies for low-income households is necessary in order to increase the now stagnating connection rate to the wastewater network. The sewer network in the northern and western parts of the city can also be expanded without major expense if funding is available, as the wastewater drains naturally to the treatment plant.
- **Monitoring and reporting:** It is important to continue monitoring the project indicators and to transfer them to other cities, even after the project evaluation has been completed.
- **Support from the ENACAL head office:** Continued commitment and investment by the ENACAL head office in Granada, even after the project has been evaluated, is important for the sustainability of the investments.
- **Technical infrastructure:** It would make sense to continue the hydraulic water distribution model from the study phase and calibrate it with real data. The model is currently not available in Granada, but only at the head office. This would be an important tool for the DDG to independently plan the expansion of the network or to define emergency measures to maximise the security of supply. Furthermore, the infrastructure has not been transferred to a GIS database, but is currently only available in *Autocad*. Additional pressure gauges should be installed in the network in order to register possible anomalies in the network more quickly, but also to calibrate the model of the network. The combination of the GIS database with the hydraulic model would be an excellent basis for sustainable operation and a further support for a sustainable reduction in water losses.
- **Maintenance and repair:** It is important to ensure a budget for maintenance (establishment of an operation and maintenance fund) and to ensure adequate staffing of the maintenance team on a permanent basis. In addition, strict operation and maintenance measures must be carried out in accordance with the private operator's maintenance plan, including

annual inspections by independent experts. In the medium term, an additional flushing truck should be purchased to maintain the sewer network in order to prevent sedimentation in the pipes, which can lead to a reduction in hydraulic capacity as well as odours. In some places, manhole covers made of plastic were used, which are not designed for the normal traffic loads of a busy road. It would therefore be advisable to use robust material for manhole covers on busy roads to avoid accidents and prevent rubbish from entering the sewer network.

- **Personnel:** The DDG staff would need to be staffed with sufficient qualified personnel in all key positions. A large rotation in staff would need to be avoided to keep the accumulated expertise within the DDG.
- **Wells:** Production in the *Quinta Ena I and III* wells would have to be discontinued as critical levels of pollutants have been reached. In the medium term, new wells would have to be drilled in the area around *Las Carolinas 1* in order to compensate for possible shortfalls (pending recommendation by the AK). The early establishment and subsequent compliance with appropriate protection zones would have to be ensured now for future well drilling.

Rating summary of sustainability: **moderately successful (3)**

In the course of the project, the executing agency ENACAL and its delegation in Granada built up substantial capacities, particularly in the areas of wastewater and operational management, and greatly expanded and rehabilitated the water supply/sewage disposal systems. The project made a substantial contribution to this. The sustainability of what has been achieved is jeopardised by limited personnel and financial resources for O&M and the DDG, as well as potentially still insufficiently fast processes for procuring spare parts and the continuing high NRW. The high level of commitment of the ENACAL headquarters to the systems in Granada played a major role in the high level of dynamism in the city's water sector; the continuation of this even after the private operator and KfW have left is crucial for the sustainability of the project and the continuation of impacts over time.

Overall assessment: **successful (2)**

The relevance of the project is rated as very successful, as it responded appropriately to the needs of the population, implemented a very robust technology in a meaningful way and responded dynamically to the need for change. Project coherence is good, as synergies were created by bundling donor-funded activities. In terms of effectiveness, the targets were partially exceeded, but there are difficulties with further increasing the connection rates to the sewage network and further reducing water losses; deficits in the collection of bills became apparent during the evaluation, even though collection efficiency generally increased significantly over the course of the project. Efficiency is rated as successful despite long delays: the outputs were produced cost-effectively, and the outcomes were largely achieved. The impact of the project is considered to be of limited success: Health impacts are plausible, ecosystem impacts less likely. However, the data is insufficient, which is why this criterion only plays a minor role in the overall project rating. Finally, sustainability shows positive tendencies, but depends on the future provision of human and financial resources and the improvement of connection rates to the wastewater disposal system and the reduction of NRW. Overall, the project meets expectations.

Contribution to Agenda 2030

In line with the 2030 Agenda, the project pursued an integrative approach that combined the economic, social and environmental dimensions of sustainable development. It also tended to be implemented in cooperation with governments, civil society and the private sector. The project has plausible links to SDG 6 (clean water and sanitation) in particular. Contributions are also plausible to the achievement of SDG 1 (no poverty), SDG 3 (health and well-being), SDG 9 (reduced inequalities), SDG 14 (life below water) and SDG 15 (life on land).

Methodology

Evaluation methodology

The ex-post evaluation follows the methodology of a rapid appraisal, i.e. a data-based, qualitative contribution analysis, and represents an expert opinion. The project is attributed effects based on plausibility considerations, which are based on a careful analysis of documents, data, facts and impressions. Where possible, this also includes the use of digital data sources and modern techniques (e.g. satellite data, online surveys, geocoding). The causes of any contradictory information are investigated, attempts are made to resolve them, and the assessment is based on statements that are confirmed by several sources of information (triangulation), where possible.

The analysis of the effects is based on assumed causal relationships, documented in the impact matrix developed during the project appraisal and updated during the ex-post evaluation, if necessary. The evaluation report sets out arguments as to why certain influencing factors were identified for the effects observed and why the project under review probably made a certain contribution (contribution analysis). The context of the development measure is taken into account in terms of its influence on the results. The conclusions are put into relation to the availability and quality of the data basis. An evaluation concept serves as the reference framework for the evaluation.

The method offers a balanced cost-benefit ratio for project evaluations, on average, with a balance between knowledge gain and evaluation effort, and allows for a systematic assessment of the effectiveness of DFG projects across all project evaluations. Individual ex-post evaluations cannot therefore meet the requirements of a scientific assessment in the sense of a clear causal analysis.

The main objective of the evaluations (knowledge interest) is to measure impacts, provide accountability, promote transparency and enable institutional learning.

Type of evaluation:

trip to the project area

Key questions of the evaluation according to the evaluation concept:

- How useful are the technical solutions from today's and yesterday's perspective? What risks are there for the sustainability of the systems?
- How useful is the design, especially the interaction between the various components?
- How high are the connection figures, which population groups were served?
- How good is the cost coverage/economic efficiency of the DDG?
- How can the significantly longer period be explained? How does this affect the efficiency of the project?

Non-public (internal) documents

Internal project documents, strategy papers, country and sector analyses.

Data sources and analysis tools

On-site interviews with beneficiaries and non-beneficiaries, expert interviews, partner monitoring data, inspection of infrastructure

Project sites visited

ENACAL office Granada, sewage treatment plant and pumping station Villa Sandino, pumping station Centro Historico, wells Las Carolinas 1, watertank El Capullo, households in sectors 1, 2, 13 and 18, CRAI and ENACAL workshops.

Interview partners and modality (in person, virtual/by telephone, in writing)

KfW (in person), ENACAL (in-person), implementation consultant (in-person), target group (in person), civil affairs office Granada (in-person), MINSA (in-person), MARENA (in-person), private operating firm (in-person)

The analysis of the impacts is based on assumed interdependencies, documented in the impact matrix developed during the project appraisal and updated during the ex-post evaluation where necessary. The evaluation report presents arguments as to why which influencing factors were identified for the identified impacts and why the analysed project presumably made which contribution (contribution analysis). The context of the development measure is taken into account with regard to its influence on the results. The conclusions are set in relation to the availability and quality of the data basis. An evaluation concept is the reference framework for the evaluation.

For project evaluations, the method offers - on average - a balanced cost-benefit ratio that balances the knowledge gained and the evaluation effort and allows a systematic assessment of the effectiveness of FC projects across all project evaluations. The individual ex-post evaluation can therefore not fulfil the requirements of a scientific assessment in the sense of a clear causal analysis.

The following aspects limited the evaluation

Lack of indicators or data at the impact level, no causal attribution of effects, temporal overlap between the evaluation mission and the transfer of operation and maintenance to the operator.

Assessment methodology

A six-point scale is used to assess the project according to OECD DAC criteria, with the exception of the sustainability criterion. The scale values are as follows:

- Level 1** Very successful: results significantly above expectations
- Level 2** Successful: results fully in line with expectations, without significant shortcomings
- Level 3** Moderately successful: results below expectations, but positive results predominate
- Level 4** Moderately unsuccessful: significantly below expectations and negative results dominate despite recognisable positive results
- Level 5** Unsuccessful: despite some positive partial results, the negative results clearly dominate
- Level 6** Highly unsuccessful: the project is useless or the situation has deteriorated

The overall rating on the six-point scale is based on a project-specific weighting of the six individual criteria. Levels 1–3 of the overall rating indicate a ‘successful’ project, while levels 4–6 indicate an ‘unsuccessful’ project. It should be noted that a project can generally only be classified as "successful" in terms of development policy if both the achievement of objectives at the outcome level (effectiveness) and impact level, as well as sustainability, are rated at least as "moderately successful " (level 3).

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