# Ex post evaluation – Nicaragua

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**Sector:** Sanitary provision and wastewater management (CRS code 14022)
**Project:** Rehabilitation of Lake Managua (Sewage Treatment Plant) (BMZ no. 1999 66 706)*
**Implementing agency:** Empresa Nicaragüense de Acueductos y Alcantarillados (ENACAL)


### Ex post evaluation report: 2018

| | | (Planned) | (Actual)** |
|---|---|---|---|
| Investment costs (total) | EUR million | 30.86 | 34.02 |
| Counterpart contribution | EUR million | 7.95 | 8.57 |
| Average interest differentials | EUR million | 2.46 | 0.00 |
| Funding | EUR million | 20.45 | 25.45 |
| of which BMZ budget funds | EUR million | 20.45 | 25.45 |

*) Random sample 2017
**) Compared with the extended scope of services at the time of the project appraisal (solar sludge drying plant; co-financing of wastewater pumping stations)

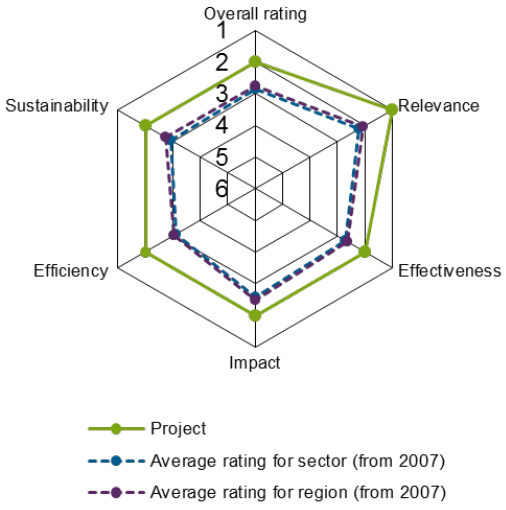
**Summary:** The FC measure was a central component of the "Programme for Rehabilitation of the Lake Managua Water Catchment Area" developed under the leadership of the Inter-American Development Bank, which included the construction of a wastewater treatment plant in the capital of Managua. This was supplemented by an innovative solar plant for drying the resulting sewage sludge. Accompanying educational and information measures were intended to help strengthen the general public's awareness of the basis for an environmentally and economically sustainable water supply and sanitation system. Operation is ensured through a management contract with a private operator (PPP model), initially financed on a pro rata and degressive basis from FC funds and now financed by the Nicaraguan partners.

**Objectives:** The aim of the FC measure was to treat and dispose the wastewater of the city Managua, which is collected centrally and discharged into Lake Managua, in an environmentally sound, hygienically safe and economically efficient manner (project objective). The overarching objectives of the project in terms of development policy were the contribution to reduce the health risks of Managuas population and to protect Lake Managua's ecosystem in the long run (overall objectives).

**Target group:** The target group were the inhabitants of Managua, whose wastewater was to be disposed of and treated (currently around 1 million people). In particular, most of the approximately 120,000 poorer people living in the immediate catchment area of the lake, which is polluted by wastewater, were intended to be the main project beneficiaries.

## Overall rating: 2

**Rationale:** The project objectives were fully achieved in most cases with minor limitations. Even though ENACAL, as a state-owned enterprise, is deficient in overall, the wastewater treatment plant covers its operating costs – a remarkable accomplishment in the wastewater sector. Measures currently being implemented to increase the capacity of the plant and produce energy of biogas have the potential to improve the financial sustainability. The success of the project is limited by the potential health risks posed by the illegal discharge of wastewater into open rainwater drains, often blocked by household waste, which continue to discharge untreated wastewater directly into Lake Managua. However, recent measurements show that the resulting impact on water quality is low. The project is rated as good in overall.




**Highlights:** A cost-effective technology well adapted to local conditions with an innovative component for sewage sludge drying was chosen for the wastewater treatment plant. The new institutional model of private sector participation in the water sector of the country with the first wastewater treatment plant of this size in the region is working reliably. The project thus set an important precedent for the further development of the sector.

# Rating according to DAC criteria

## Overall rating: 2

### Ratings:

| | |
|---|---|
| Relevance | 1 |
| Effectiveness | 2 |
| Efficiency | 2 |
| Impact | 2 |
| Sustainability | 2 |

### General conditions and classification of the project

The FC measure was a central component of the Programme for "Rehabilitation of the Lake Managua Water Catchment Area" developed under the leadership of the Inter-American Development Bank, which was financed with parallel financing from IDB, the Nordic Development Fund and KfW. The plan was to finance the wastewater treatment plant for Managua (the country's capital city) from FC funds, with the six pumping stations to be financed by the NDF and the wastewater network by the IDB. Due to the non-functional pumping stations financed by the NDF, EUR 1.7 million in FC funds was injected to rehabilitate them, thereby ensuring proper operation of the sewerage system and the wastewater treatment plant.

### Relevance

Lake Managua fulfils important functions for the residents of Managua. The people living next to the lake in particular using the water for cooking, washing and irrigation, and fishes from the lake are an important part of their diet. Lake Managua also serves as a reservoir, which is strategically important for water supply in times of climate change.

Prior to project implementation, untreated wastewater from Managua was discharged directly in open sewers into the lake for many decades, resulting in considerable odour pollution. Frequent flooding along the banks of the lake and direct contact with lake water through cooking, washing and irrigation of vegetable crops for raw consumption have created significant health risks, in particular for the population living close to the lake. The strong odours made the shoreline unappealing. At the time of the project appraisal (PA), the drinking water wells inside the urban area were also contaminated and the vital drinking water resources located in the west of Managua were also endangered in the long term.

The assumed chain of effects is conclusive in general: by properly disposing of the resulting wastewater and ensuring adequate residential sanitation, the project aimed to contribute to the preservation of the surface water of Lake Managua and the groundwater resources. An additional aim was to prevent the spread of water-based diseases.

The planned project concept was well suited to solve the above-mentioned problems. The strategy of concluding a management contract with a private operator, financed on a pro rata and degressive basis from FC funds, stood to reason in view of the implementing agency ENACAL's lack of experience in operating wastewater treatment plants of this size at the time of the project appraisal. In addition, it had the potential to contribute to the introduction of new institutional operating models in Nicaragua.

The project was in line with the Nicaraguan government's strategy for the water and wastewater sector. Over the course of the project, the Nicaraguan government repeatedly emphasised its high priority. The project also serves to protect drinking water resources and it already included sustainable sewage sludge management in its concept. This means that it is in line with the water sector concept of the German Federal Ministry for Economic Cooperation and Development (BMZ).

The donor cooperation (parallel financing with IDB and NDF) set out in the concept was very well suited tohelping to solve the problem. From today's perspective, the project had very high relevance in terms of

development policy.

**Relevance rating: 1**

### Effectiveness

The project objective (module objective) of the FC measure was to treat and dispose of the wastewater of the city of Managua, which is collected centrally and discharged into Lake Managua, in an environmentally sound, hygienically safe and economically efficient manner (project objective). These objectives are also appropriate from today's perspective.

The achievement of the project objectives can be summarised as follows:

| Indicator | Status PA, Target PA | Ex post evaluation |
|---|---|---|
| (1) The organic pollutant load measured in terms of biological oxygen demand (BOD content) at the outlet is less than 90 mg/l (unfiltered sample) [1)] | -<br><90 | 34<br>Target clearly surpassed. |
| (2) The share of faecal coli bacteria at the outlet in the lake (100 m from the outlet pipe) is less than 500,000 MPN (most probable number)/100 ml [2)] | -<br><500,000 | 424,000<br>Target met. |
| (3) There are no more than 40 days per year of complaints about unpleasant odours caused by the treatment process outside the immediate vicinity of the plant (distance of less than 300 metres). | -<br>40 | 0<br>Target met. |
| (4) 80% of the wastewater treatment plant's capacity is utilised (equivalent to 146,000 $m^3$/d).[3)] | -<br>80% | 84%<br>Target met. |
| (5) The management contract payments for operation of the wastewater treatment plant (including solar drying plant, without electricity costs) are financed entirely from tariff revenues for wastewater treatment. | -<br>100% | 100%<br>Target met. |
| (6) The operating costs of the wastewater treatment plant (including the solar drying plant and wastewater pumping stations, with electricity costs) are fully financed from the wastewater treatment tariffs. | -<br>100% | 99%<br>Target nearly met. |
| (7) NEW: the target connection rate of the population to the public wastewater network is at least 75%. | 58%<br>75% | 75% (2015), 80% at time of EPE<br>Target met. |
| (8) NEW: proper disposal of sewage sludge | -<br>Achieved. | The sewage sludge is properly disposed of and the objective has thus been achieved. |

1) Limit value of the Nicaraguan standard refers to unfiltered sample; (at time of PA: 50 mg/l for filtered sample)

2) At time of project appraisal: <10,000 MPN/100 ml

3) Wastewater treatment plant capacity was increased from 157,500 $m^3$ to 182,600 $m^3$/d at the time of construction planning in order to compensate for delays in the project.

The target value for Indicator 2 complies with the standards laid down in Decree 77-2003 for the Managua wastewater treatment plant. This decree is based on the immission principle.1 As a result, it was possible to eliminate the need for a third treatment stage (as planned at the time of project appraisal), given that the microorganisms contained in the wastewater are largely degraded in the lake through its self-cleaning properties.

In 2016, the treatment plant's capacity utilisation level was 83% and the plant was in operation for 363 days.

Since the wastewater treatment plant became operational, the unpleasant lake odours have disappeared and the water quality has improved demonstrably. In the meantime, the municipal administration has further developed the waterfront, where it has established an attractive local recreation area. Most of the people living in the immediate vicinity of the shore have now been relocated to areas slightly higher up and supplied with a connection for drinking water and sanitation.

The project received a total of three awards, including the Global Water Award in 2010 for the world's largest solar plant for drying sewage sludge. Between August 2016 and July 2017, around 8% of the resulting sewage sludge was sold (82%) or given away (18%) in the form of fertiliser pellets to farmers; the remaining sewage sludge is properly stored at the Managua landfill, which was rehabilitated with Spanish partner support.

Even if a small part of the wastewater (less than 10%) is still discharged illegally into the lake via the rainwater drains, the effect on the lake water quality is minor. We therefore rate effectiveness overall as good.

**Effectiveness rating: 2**

### Efficiency

The technology implemented represents a cost-effective, environmentally friendly and economical solution adapted to local conditions. In 2016, the total operating costs of the wastewater treatment plant amounted to USD 0.023/m³, making them extremely low compared to the higher-value technology used and similar DC projects. 99% of the wastewater treatment plant's operating costs were covered in 2016, including all components of the wastewater treatment plant, wastewater pumping stations, sewage system and energy costs.

At EUR 46 per inhabitant, the specific investment costs reported (based on the 2010 design horizon and the connected population) are around 15% higher than the estimates at the time of the project appraisal (EUR 40 per inhabitant). Yet, in view of the 36% increase in the scope of services as well as the technology used, they are very low by international standards. Even from today's point of view, no cheaper technical alternatives would have been possible. Production efficiency is therefore rated as very good.

The existing concept has the potential to expand the plant to the 2025 planning period with relatively low additional investments (<20%) and to further reduce the operating costs by using biogas (as envisaged in project BMZ no. 2012 65 719).

In terms of allocation efficiency, more than 800,000 residents of Managua are currently connected to the wastewater network and thus to the wastewater treatment plant as planned, which reduces the risk of water-induced diseases (see Impact section below). Although the collection efficiency of 77% (as of 2016, with a slight upward trend) is not good, it can still be considered satisfactory in view of the very difficult general conditions and the increases in wastewater tariffs.

Overall, we rate the efficiency as still very good.

**Efficiency rating: 2**

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1 Protection against harmful effects at the actual point of contact, in contrast to the emission reduction principle, which involves the reduction or avoidance of pollutants at the point of origin.

### Impact

The overarching aim of the FC measure in terms of development policy was the contribution to reduce the health risks to the population of Managua and to protect Lake Managua's ecosystem in the long run (overall objectives).

The water quality of Lake Managua has improved significantly since the construction of the wastewater treatment plant, as evidenced by regular measurement campaigns in the lake. The project thus contributed to protect Lake Managua's ecosystem and reduced the health hazards associated with the discharge of untreated wastewater into the lake.

According to data from the Ministry of Health, a slight decline in water-induced diseases (malaria, dengue, diarrhoea, hepatitis A) has been seen in the municipality (*municipio*) of Managua since the wastewater treatment plant became operational. Furthermore, the child mortality rate in the administrative district of Managua decreased from 16.1 (18.5 with Ciudad Sandino) live births per 1,000 inhabitants in 2000 to 12 live births per 1000 inhabitants in 2011/12. This significant improvement in the health indicators cannot be traced solely to the effects of the wastewater treatment plant, but must be attributed to a large number of factors.

The project made a proven contribution to significantly reducing the unpleasant odours around Lake Managua. The supplementary activities of the municipal administration to extend the waterfront promenade made it possible to transform the shoreline into an attractive local recreation area.

From today's point of view, there is still a risk that the overall objectives will not be achieved. Households currently not connected to the public sewerage system or to septic tanks (less than 10%) discharge their wastewater into the open rainwater drains (*cauces*), which continue to flow directly into Lake Managua. The accumulation of household waste (including electrical waste) in these rainwater drains further exacerbates this problem, especially as they are not cleaned regularly. The responsibility for rainwater disposal lies with the municipality, which has recognised the problem but has not yet undertaken any effective measures.

One positive aspect worth mentioning is the precedent set by the operator model successfully piloted in connection with the wastewater treatment plant in a public-private partnership.

The development objectives identified during the project appraisal have been achieved. The environmental and hygiene situation in the city, along the banks and in the area next to the lake has improved considerably. If illegal discharge could be stopped, the impact could be slightly improved.

**Impact rating: 2**

### Sustainability

One risk to the sustainability of the project is the ongoing operating cost deficit of the implementing agency, ENACAL, which operates nationally. ENACAL's financial situation has improved as a result of tariff increases in recent years and the entry into force in 2016 of the special reduced energy tariff for ENACAL. ENACAL regularly receives state subsidies to cover the deficit.

The energy generation from the sewage gases planned under FC project BMZ no. 2012 65 719 (Managua Sewage Treatment Plant: Biogas and Solar Sludge Drying) will make a positive contribution to covering costs and to the project's financial sustainability. The sale of the nutrient-rich, dried sewage sludge granulate as organic fertiliser for farming and forestry also has the potential – albeit small – to improve financial sustainability.

Overall, operation of the plant by the private operator is satisfactory. The operating contract, which was originally set for five years and financed from FC funds on a pro rata and degressive basis, was initially extended by 3 years until the end of December 2017. Operation of the wastewater pumping stations was also incorporated into the operating contract in March 2014. The operator contract was then extended for a second period of five years until the end of 2022. ENACAL is responsible for the costs of extending and expanding the scope of the contract. From our point of view, there could be a risk in the medium term with respect to the sustainable operation of the plant that, despite the qualification measures for selected ENACAL employees, ENACAL will not currently have sufficient capacity to continue to operate and main-

tain the plant satisfactorily in the event that the operating agreement is terminated. Another major problem would be the procurement processes within ENACAL as a state-owned company, which are too cumbersome to ensure that spare parts can be procured quickly.

There is potential for improvement with regard to the continuous monitoring of the water quality of Lake Managua, including independent oversight of industrial operations, which is currently inadequate due to a lack of financial, technical and human resources. The Ministry of the Environment (MARENA), the national water authority (ANA) and the regulatory authority (INAA) are responsible for supervision by law. In practice, ENACAL and industrial plants not connected to the sewerage system with their own wastewater disposal are monitored mainly by analysing the reports submitted by these institutions.

The rather weak position of the implementing agency ENACAL could be successfully handled in the project by introducing private-sector structures to operate the wastewater treatment plant and pumping station, and there is even potential for the project to make a positive contribution to ENACAL's financial situation. We regard this as highly positive. Overall, we therefore rate the project's sustainability as good with the minor limitations mentioned.

**Sustainability rating: 2**

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

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

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

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

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

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

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

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

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

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