

Water Supply Expansion Project in Juigalpa, Nicaragua

Loan Agreement No. : NIC-002-2004, NIC-004-2007

Year Month Date : 2005. 09. 12 (NIC-002-2004)

2008. 10. 15 (NIC-004-2007)

Country : Nicaragua

The Export-Import Bank of Korea
(Government Agency for the EDCF)

EDCF Evaluation Team

(Evaluated by Institute of International Affairs,
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I. Project Outline

- This project was implemented with the goal of solving the chronic water shortage in the projects area, improving health and sanitation in the locality, and improving the quality of life for residents by expanding the underdeveloped water supply system in Juigalpa, Nicaragua.

- After support for the project was approved in October 2004, the bidding price significantly exceeded the initially planned project expenses due to an increase in international raw material prices and other causes. Therefore the scope and the period of the project were altered and divided into a first stage (August 2006 - December 2008, 28 months) and a second stage (December 2008 - February 2010, 14 months).

[Project Information and Expense]

Loan Agreement No.	Component	Expected*	Actual	Difference
NIC-002-2004 (1st Phase)	Total Project Cost	21,510	20,600	910
	EDCF Loan	17,200 (16,666 mil. won)	17,199 (16,665 mil. won)	1 (1 mil. won)
NIC-004-2007 (2nd Phase)	Total Project Cost	19,920	19,920	-
	EDCF Loan	15,943 (21,746 mil. won)	15,935 (21,734 mil. won)	8 (12 mil. won)

* Purchasing Contract: 1st Phase Oct. 2006 (\$1=968.9 won), 2nd Phase Dec. 2008 (\$1=1,363.94 won)

- The Project Executing Agency (PEA), Empresa Nicaragüense de Acueductos y Alcantarillados (ENACAL) was separated from Instituto Nicaragüense de Acueductos y Alcantarillados (INAA) in 1998 and was established independently as a non-profit organization invested by the government, to be in charge of the administration and

management of the water supply and sewage system. In addition, it carries out the development of the water supply and sewage system and provides other related technical assistance.

- ENACAL divides the 15 states in Nicaragua, except for Jinotega and Matagalpa, into six districts (one where it is headquartered and five where it has regional offices) and supplies tap water to approximately 180 regions.
- Juigalpa is the capital city of Chontales state and has approximately 70,000 inhabitants. It is also a center of stock-farming and a rapidly growing region. However, considering its geographical importance and growth rate, the city had poor access to water and as a result its inhabitants suffered chronic water shortages.
- Tap water was supplied once in 2 to 4 days during the wet season and two or three times a month during the dry season. When tap water was supplied, people stored water in a water tank or a bucket and when there was insufficient volume of tap water, a well was used complementarily. Around 2,000 households without water supply usually used a well or collected rainwater. Especially during the dry season, the well went dry and the water supply was shut off frequently so that residents had to purchase water from water wagons operated by small businesses.
- The existing water source, Pirre River, has supplied water in very irregular and insufficient volumes, and the quality of water is inappropriate for use by the citizens. Unlike in other regions in Nicaragua, groundwater levels are too low to offer stable water supply. Furthermore, the water purification plant and the plumbing system were so antiquated that there was an urgent need to replace them.
- The scope of this project included development of a new source of

water (Lake Nicaragua), installation of water intake facilities, laying aqueducts, building more pressurizing facilities, expansion of a water purification plant, replacing and laying water pipes, and connecting new water pipes. The project was divided into two stages of implementation.

- The first stage focused on the up-stream of water supply and consisted of installing water intake facilities and aqueducts. The second stage focused on the down-stream of water supply and consisted of expanding a water purification plant, a water reservoir, laying water pipes and connecting water faucets. Both stages were concluded as planned.

- The forebay was constructed in Puerto Diaz, located on the coast of Lake Nicaragua and 29km southwest of Juigalpa. The aqueduct from forebay to Juigalpa was laid following the road around the stock farming district, and the water purification plant and water pipes were built in Juigapa.

[Project Statement of 1st and 2nd Phase]

Classification		1 st Phase	2 nd Phase	Notes
Water Intake Facility	Intake Method	Intake tower construction	-	Change in designing the intake method (Floating→Well)
	Intake Pump	Q=90ℓ/s 2 sets (1 set in spare)	Q=90ℓ/s 2 sets	Increase in number of pump (3→4)
	Trebling Screen	-	Q=270ℓ/sx1 set	Increase in stability through adding more facilities
	Water Seam Facility	-	V=13.7m ³ x1 set	"
Pressurizing Facility	Pressurizing Pump	Q=90ℓ/s 2 sets (1 set in spare)	Q=90ℓ/s 2 sets	Increase in number of pump and capacity (3→4)
	Water Seam Facility	-	V=13.7m ³ x1 set	Increase in stability
Aqueduct	Supply and laying of aqueduct materials	- Total 27.4Km Diameter 600mm	-	Increase in efficiency through expanding diameter
Water Purification Facility	Water purification plant	-	180 ℓ /s	Expanding capacity of equipment
	Pure water reservoir	1,200m ³	-	
	Improving existing water purification plant	-	Existing facility repair including cant board repair	Improving efficiency of existing water purification plant added
Water Supply Facility	Water reservoir	-	- Highland V=410m ³ x1 - Lowland V=1,200m ³ x2	Supply of water reservoir for highland and lowland added
	Water pipe network (materials)	-	44.8km	-
Water System	Gauge (materials)	-	1,800 households	-
Others	Consulting	-	Supervision, technical assistance	New employment
Project Cost (EDCF Loan)		US\$21.51 million (17,20 million)	US\$19.92 million (15,943 million)	

- The project team recognized the basic problem of River Pirre, so it changed the main water reservoir to Lake Nicaragua in order to secure a stable source of water. This project represents the first water supply system in Nicaragua to use a lake as its source of water and is considered an innovative approach. Since the successful completion of this project, several projects which exploit lakes as water sources are in the works in other regions that are suffering from water shortages.

- After the completion of this project, the percentage of households with access to water has increased sharply from 77% to 95% and it became possible to supply water on a permanent basis. As a result of this project, the right of access to potable water has improved in every aspect including price, water quality, quantity consumed, and convenience. Also, the environment for health and sanitation as well as education has improved, which enhanced the quality of life for residents.

- The project evaluation is based on the integrated evaluation guideline and evaluation manual of the Committee for International Development and Cooperation (CIDC), and the evaluation manual and ex-post evaluation guidelines of EDCF. Also, the project is evaluated based on the five evaluation criteria of OECD DAC: Relevance, Efficiency, Effectiveness, Impact, and Sustainability.
 - In the field survey, high-ranking Nicaraguan government officials (the Vice-minister of the Ministry of Finance and the Director of a bureau in charge) and the head of the Project Executing Agency (PEA) were interviewed. Specialists at the Inter-American Development Bank (IDB) and the World Bank who have undertaken similar projects in Nicaragua were also interviewed. The conditions of the facilities and their operation were examined through an on-site visit, and residents of the project region were interviewed to ascertain the voice of the direct beneficiaries of this project. Also,

directors in the department for education and the health center in the region were interviewed in order to estimate the impacts on education and health.

- In addition, since water supply has impacts on various areas such as health, education, environment and gender, the effectiveness and impacts of this project were evaluated using the cost-benefit analysis (calculating NPV). The cost-benefit analysis is considered an appropriate method to complement the qualitative evaluation according to DAC criteria.
- The evaluation result combines the evaluation against the DAC 5 criteria with the cost-benefit analysis. Additional costs that might be incurred in the long run as a result of possible environmental and hygienic issues caused by the increase in sewage from using more water is not considered in the cost-benefit analysis. Instead, they are considered in the evaluation against the criteria of relevance and sustainability.

II. Assessment by Evaluation criteria

- The evaluation of this project follows the CIDC Integrated Evaluation Principles and DAC evaluation criteria (Relevance, Efficiency, Effectiveness, Impact and Sustainability) established by "EDCF ex-post Evaluation Guidelines". The evaluation rated this project as 'highly successful' (3.8/4.00)

[Overall Evaluation Table]

Criterion	Weight	Evaluation Item	Rating Description	Rating Value
Relevance	20%	<ul style="list-style-type: none"> - Consistency with water supply and sewage system development policies and priorities of the partner country - Consistency with the EDCF's assistance strategies - Harmonization with International Development Cooperation norms such as MDG, cross-cutting issues and Water supply aid policies - Adequacy of Feasibility study and Project design 	Relevant	3
Efficiency	20%	<ul style="list-style-type: none"> - Efficiency of project cost - Efficiency of project time period - Efficiency of project implementation procedures 	Highly Efficient	4
Effectiveness	20%	<ul style="list-style-type: none"> - Achievement of planned outcome - Achievement of project purposes - Application of appropriate technology on a local level 	Highly Effective	4
Impact	20%	<ul style="list-style-type: none"> - Socio-economic impact - Systemic impact - Impact on gender equality and environment 	High Impact	4
Sustainability	20%	<ul style="list-style-type: none"> - Systemic sustainability - Financial sustainability 	Highly Sustainable	4
Overall Evaluation Score			Highly Successful	3.8

- First, the evaluation of relevance is based on consistency with water supply and sewage development policies and priorities of the partner country, consistency with EDCF's assistance strategies, and harmonization with international development cooperation norms such as MDG and adequacy of project design. The evaluation on this score rated the project as '**relevant**'(3.0).
- This project is considered to be highly relevant since water supply is a top priority of the National Development Plan of Nicaragua. Moreover the selection of the target region and beneficiaries fully reflected the recipient's needs and water supply conditions in the project region. Also, water supply and sewage systems have been the primary target sector under the EDCF Strategic Management Plan of 2006~2009, and therefore this project highly corresponds to the EDCF development policies.
- In terms of harmonization with international development cooperation norms such as MDG, cross-cutting issues, and water supply aid policies, this project is found to be 'highly relevant'. It increased the percentage of the population with access to clean water, where the main beneficiaries are women, who were in charge of fetching water before conducting this project. Thus this project is deemed to have contributed to gender equality.
- However, this project did not properly consider risk factors as it failed to take into account the importance of a sanitation system. Since the objectives of this project were not only to mitigate the shortage of drinking water through the expansion of water supply but also to enhance health and sanitation, the danger posed by the lack of a sewage system could have been considered in advance, given that an inadequate sewage system can adversely affect health and hygiene in future. Therefore this matter should have been recognized earlier and reflected in the planning stage. In future water supply projects, ex-post environmental degradation and deterioration of sanitation resulting from earlier water projects and the

corresponding increase in sewage volumes should be anticipated. It would also be necessary to devise minimum safeguard measures at the planning stage.

- Second, in terms of efficiency, this project is found to be '**Highly efficient**' (4.0points) considering its cost, time period, and implementation procedures.
 - The cost-benefit analysis results of this project show that the project yielded larger benefits compared to its costs, supporting the 'highly efficient' rating. The project was also positively viewed in terms of its time management, because it was completed 4 months earlier than scheduled despite having been divided into 2 phases after its initial approval. Communication and business transactions with EDCF during the implementation of the project were likewise positively reviewed.
 - On the other hand, the project did not properly establish specific performance indicators regarding efficiency of implementation procedure at the appraisal stage. This is understandable, however, because the project was executed in the early stage of development of EDCF's project performance indicators and it was difficult to apply them at the time. For future water supply projects, EDCF should set concrete evaluation indicators which can measure specific achievements such as the number of households newly connected to water supply (water supply distribution rate), changes in the rate of water usage by locals, and improvements in the welfare of residents.
- Third, on the basis of major indicators for evaluating effectiveness such as achievement of planned outcomes, achievement of project purposes, and application of appropriate technology (AT) on a local level, this project has been rated as '**highly effective**' (4.0).
 - The project achieved every objective of its first and second phases.

Its operation, maintenance, and repair are also under proper control. In terms of achievement of project purpose, the water supply ratio has jumped from 77.15% to 95.09%. Moreover, the stabilization of water supply and improvement in water quality enhanced access to drinking water in every aspect such as price, quality, usage, and convenience.

- In terms of application of appropriate technology (AT), the project has effectively considered the geographical feature and technological level of the project area. In particular, this project is the first in Nicaragua to utilize a lake as a forebay. It is regarded an exemplary case which other water projects are benchmarking.
- Fourth, this project is found to be '**highly influential**' (4.0 points) regarding its socio-economic, institutional, environmental, and gender equality-related impact.
 - This project has made significant contributions to the quality of life and living environment of its direct beneficiaries, the residents of Juigalpa. It has also made considerable socio-economic impact on vulnerable social groups such as women, children, and the poor. Locals who earlier either fetched water from wells or purchased from water trucks have seen their living expenses fall. Moreover, better opportunities in labor and education lend proof to the overall improvement in the quality of life as a result of regular water supply. Improved water quality also positively affected health and living standards. Improvements to the education and health sectors brought about by the project are expected to stimulate the local economy as well.
 - In institutional terms, this project contributed to Nicaragua's capacity building in the water sector and provided the impetus for ENACAL, the project executing agency (PEA), to execute the project. Its estimated adverse environmental impacts are minimal, but follow-up measures are needed due to the lack of a sewage system.

- Fifth, in terms of systemic and financial sustainability, this project is deemed '**highly sustainable**' (4.0 points)
 - It is evident that there is institutional stability to support the sustainability of this project as the Government of Nicaragua will have ownership and management authority over the water system. However, it is highly recommended to encourage and strengthen the participation of the recipient government from the planning stage of the project for the empowerment of the recipient country since Nicaragua tends to depend more on foreign aid than its own finances for the project.
 - Financially, due to the underpricing and non-billing of water, Juigalpa's water supply operation depends largely on government subsidies. However, as ENACAL headquarters manages the overall system and covers its nation-wide budget, there will be no serious risk to financial sustainability. ENACAL's Juigalpa branch has developed an independent plan to reduce operating costs and increase revenue, which is a positive sign for financial sustainability. In the long run, the current underpriced rate must be rationalized. However, this is an issue that lies beyond the scope of the sustainability evaluation because cheap water is a structural problem of the recipient government.

III. Cost-Benefit Analysis

- Cost-Benefit Analysis is a useful tool to evaluate the efficiency of the project and the feasibility of the development assistance by quantifying its economic and other benefits.
- To calculate the Net Present Value (NPV) of the project, data collected from field investigation were used for a quantitative analysis on the efficiency and impact of the water expansion project in Juigalpa.

- Cost of operating new facility and maintaining old facilities
 - Water source, price, and time spent to obtain water before the execution of project
 - Changes in quantity of water use before and after the project
 - Changes in water rate and amount supplied, before and after the project
 - Changes in water related disease (if decreased)
 - Changes in absence rate (if decreased)
- In the benefit analysis, we used Net Present Value as the measure of calculation. The equation used for calculating NPV is as below.

$$NPV = \sum_{t=0}^n \frac{B_t - C_t}{(1+r)^t}$$

B: Benefit (Including all kinds of social benefits generated from the project)

C: Cost (Including mostly initial investment and cost of O&M)

[Water use in Juigalpa based on regional classification]

Classification	Fringe Area		Residential Area		Central Area	
	Region without water connection (low income)		Water connected residential area (medium income)		Commercial Area	
Population	household:2000 population: 12,000		household: 6,000 population: 36,000		household: 3,000 population: 18,000	
Income (/month)	\$100-150		\$150-300		over \$300	
Major source of income	house keeper (\$100/month)		civil servant, teacher, self employed		store, restaurant, self employed(store, restaurant etc.)	
Use of water	Raining Season	Dry Season	Raining Season	Dry Season	Raining Season	Dry Season
Amount of use (m^3 /month)	3~4	3~4	20	10~15	40	15~30
Major source of water	well	water truck	tap water/ well	tap water/ water truck	tap water	tap water/ delivery (in person)
Cost generated from lack of water supply	<ul style="list-style-type: none"> - time spent for fetching water - water price (from water truck) - inconvenience and time spent for purchasing water from water truck 		<ul style="list-style-type: none"> - water price (from water truck) - inconvenience and uncertainty when using tap water 		<ul style="list-style-type: none"> - cost of delivering water by vehicle - inconvenience and uncertainty when using tap water 	

Sources: Statistics in Juigalpa, resident survey, interview with director of ENACAL

- For discount rates ranging from 8 to 12 percent, the NPVs and ratios of benefit to cost are as below.

[table 8. NPV and ratio of benefit to cost]

Discount rate	NPV	B/C
8%	33,597,094	1.71
9%	26,308,096	1.57
10%	20,174,695	1.44
11%	14,973,178	1.33
12%	10,529,080	1.24

- The Cost Benefit Analysis is based upon data collected from field investigation. The ratio of NPV of benefit to NPV of cost at a discount rate of 10% is 1.44 for 35 years after the completion of the project. Therefore this project is found to be economically successful as well.
- The result of the discount rate sensitivity test also proved that NPV remained positive within the discount rate range of 8 to 12 percent.

IV. Lessons & Suggestions

1. Lessons from the project

- This project has been evaluated as highly successful since it solved the chronic shortage of water in the target region by developing a new forebay (Nicaragua lake). It contributed to the improvement of water quality, health conditions, and living standards of residents.
- As the first water project in Nicaragua to tap into a lake as an abundant source of water, the project has encouraged other regions to pursue similar projects. This project also contributed greatly to the recipient's project planning and procedure management capability, which would be the key to success in follow-up projects.
- According to the cost-benefit analysis, this project was highly cost efficient. Moreover, the project procedure was considered excellent by the recipient government and ENACAL in terms of rapid and

smooth communication and project management.

- Water supply projects usually result in high satisfaction for the beneficiaries; furthermore it is considered a sector where EDCF has comparative advantage.
 - The direct recipients of this project, the residents of Juigalpa, experienced remarkable improvement in their quality of life. The residents expressed their gratitude for benefits from this project. The evaluation by the Government of Nicaragua was very positive as well.
 - However there are some factors to be considered from the stage of feasibility study; local geographies, technological levels and capabilities, institutions and water rate systems vary in different localities. Therefore it is necessary to closely examine these factors and incorporate risk elements in the project plan for each recipient country.
- Finally, in the planning and implementing stages of future projects, EDCF should consider the following problems:
 - Neglect of risk caused the sewage system to be excluded from the plan. If this project properly considered risk factors arising from the increase of sewage and provided for basic sanitary facilities such as a ditch, it could have reduced costs and magnified its beneficial impacts on health and the environment.
 - Even though no serious problem occurred in the implementation stage of the project, the lack of performance indicators is another shortcoming of this project. Although the absence of performance indicators does not greatly affect the project, well-established indicators are helpful to measure the exact achievement of development assistance. For the evaluation, it is important to develop specific indicators and a target index in advance, and they

should be used for project monitoring and ex-post evaluation.

- Furthermore, the decrease in operational efficiency owing to the low water rate and increase in non-billing is an additional problem. Fortunately, ENACAL has a plan for reducing operating expenses and improving the water meter system to enhance its profit. However it is better to consider this type of risk from the planning stage and prepare remedial measures.

2. Suggestions

A. Consideration of a sewage system from the planning stage of the water supply project.

- As water supply increases, so does water consumption and sewage. Thus there should be a preparation of minimum counter measures with consideration of sewage and its negative impact on environment and sanitary condition from the planning stage of the project.
- It is an international trend to include sewage systems in water supply projects. However, recipients tend to exclude sewage treatment in their projects because of its associated cost. Donors need to take this into account and incorporate the system from the early stage of the project. At the minimum, measures such as digging ditches can significantly boost the effectiveness of the project in improving health and environmental conditions with a relatively small outlay.
- Chontales, the higher administrative district of Juigalpa, also does not have a sewage system and has low interest in it. Neither do residents show any dissatisfaction with the result as water shortage has been resolved for now. However, as wastewater flows on the road, sanitation, health conditions, and underground water pollution are expected to deteriorate in the long term. This points to a need for follow-up action.

B. Developing specific performance indicators

- For future projects, it is necessary to establish project-related performance indicators and apply them to the evaluation.
 - Performance indicators of this project mainly focus on outputs such as facility capacity, maximum amount of water supplied, etc. But they are not sufficient to evaluate the performance vis-a-vis the goal of this project. Thus, developing performance indicators such as water supply distribution, change of water consumption, and welfare increase is important to monitor projects and conduct ex-post evaluations.
- The development of such performance indicators will facilitate the measurement of effectiveness and efficiency based on cost-benefit analyses. It will also contribute to the objective evaluation of the performance and feasibility of the project.
 - It is relatively easy to conduct cost-benefit analyses on infrastructure sector projects compared to other EDCF project areas. It is worthwhile to consider establishing an evaluation plan at the planning stage of project and set appropriate performance indicators to collect corresponding initial data. This data could provide a useful tool for comparative analysis at the ex-post evaluation stage.

C. Harmonization with other donor countries in related projects.

- This is suggested to avoid overlap of development projects in recipient countries and to build a cooperation system among donors to pursue aid harmonization. It is necessary for EDCF to participate in dialogue with recipients and donors in related fields and offer advice and cooperation in the policy-setting and project planning of the recipient government. This will be an opportunity to publicize Korea's development cooperation and learn from each other.

- Currently, Nicaragua is establishing a master plan with donor countries to manage its national water system. Furthermore, a roundtable for donors in the water sector is being hosted by the World Bank. However, Korea is not participating in the meeting and thus cooperation with other donors is still difficult. In order for Korea to play a leading role in related development projects, it is recommended that it participate in dialogue and networking opportunities with other donors to improve the effectiveness and efficiency of its aid projects.