

Approaches to the financial evaluation of the “El Ahogado” wastewater treatment plant in Jalisco, Mexico

Aproximaciones a la evaluación financiera de la planta de tratamiento de aguas residuales “El Ahogado” en Jalisco, México

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Abstract

Purpose: To generate financial feasibility indicators for the “El Ahogado” wastewater treatment plant project in Jalisco, Mexico, as an integral part of the water sanitation system in the Guadalajara Metropolitan Area (AMG). **Methodology:** Model of Public-Private Partnerships (PPP) for the development of social infrastructure works. A research object is adapted to a retrospective case study for its current application in Mexico. The financial feasibility analysis includes an evaluation of the financial costs regarding the revenues and subsidies delivered to the developer periodically and those received for water recovery per month. **Contribution:** This study allows us to conclude that for the financial conditions for the development or private capital in the “El Ahogado” treatment plant project, it was not financially viable given the maintenance and operation costs required in this infrastructure.

Wastewater treatment plants, Public-Private partnership, Financial viability

Resumen

Objetivo: Generar indicadores de factibilidad financiera para el proyecto de la planta de tratamiento de aguas residuales “El Ahogado” en Jalisco, México, como parte integral del sistema de agua potable de la Zona Metropolitana de Guadalajara (AMG). **Metodología:** Modelo de Asociaciones Público Privadas (APP) para el desarrollo de obras de infraestructura social. Se adapta un objeto de investigación a un estudio de caso retrospectivo para su aplicación actual en México. El análisis de factibilidad financiera incluye una evaluación de los costos financieros en cuanto a los ingresos y subsidios entregados al desarrollador periódicamente y los recibidos por recuperación de agua por mes. **Contribución:** Este estudio permite concluir que por las condiciones financieras para el desarrollo o capital privado en el proyecto de la planta de tratamiento “El Ahogado”, no era viable financieramente dados los costos de mantenimiento y operación que requiere esta infraestructura.

Plantas de tratamiento de aguas residuales, Asociación público-privada, Viabilidad financiera

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Introduction

The conservation of natural water sources is an issue that concerns humanity in general. Rivera, Chávez, and Salinas (2018) point out that natural resources have suffered great impacts; among them water, this liquid has suffered an increase in demand due to population growth, generating pollution due to the discharge of garbage and waste to natural sources such as rivers, lakes, seas, a problem that has been getting worse over the years. In the international sphere, McGillivray (2008) comments that the United Kingdom, through the United Kingdom Department for International Development (DFID), demonstrates its experience in private investment projects for the development of infrastructure, mainly in poor countries. In the case of the Water and Sanitation Program (WSP), electricity, telecommunications, and transport programs in 2003, the Global Association for Results-Based Aid (GPOBA), formed by the World Bank with the support of the United Kingdom United, considers that delegating responsibility for the provision of public services to a private company or Non-Governmental Organization NGO is an effective strategy for financing or if it is justifiable to apply subsidies based on results, especially to low-income users.

Unfortunately, the economic issue is not addressed with much research in this regard since there is no consensus to evaluate the projects, high costs, limitations, and obstacles that they present (Senante, Sancho, and Garrido 2010). The collection of a fee that guarantees the management of wastewater treatment to the users allows the use of public resources for other purposes, guaranteeing optimal service and generating awareness of rational consumption among users (Moral-Pajares, Gallego Valero, and Román-Sánchez 2019). For their part, Lindtner, Schaar, and Kroiss (2008) pointed out that wastewater treatment plants in Australia are publicly owned and operated by the public sector and private companies.

Debaere and Kapral (2021) address the problems that several countries in the world are experiencing due to water scarcity. For countries with strong economies, the participation of private investment in their different financing schemes (Public Private Partnership - PPP) can be a good strategy to solve water problems, taking advantage of their experience, a calculation more in line with user prices to guarantee the works and innovation that they have been developing due to market competition. The United Nations, addressing the challenge of the water problem to guarantee its availability and sanitation, implements it in its agenda as the Sustainable Development Goal 6 (SDG6), focused mainly on low-income and developing countries, since 61% of the world's population does not have sanitation services. Africa is no exception, and the struggle to provide this service. Ghana approved in 2010 under the supervision of the Government; the polluter pays policy, in addition to this, the public sector, to positively improve sanitation services, should review the implementation of PPPs as a financial alternative to this problem (Tanoh, Nikiema, Asiedu, Jayathilake, and Cofie, 2022).

Van Dijk, Etajak, Mwalwega, and Ssempebwa (2014) comment that among some of the obstacles that exist to offer a better sanitation service to the most unprotected communities, a better financing scheme and a mechanism to generate income can be highlighted for the support of the projects undertaken. The industrial sector is the one that pollutes the most and uses the water resource the most. Industrialized countries produce approximately 80% of hazardous substances and 70% in developing countries, which directly dump the waste into their natural water sources (Rodríguez, Letón, Rosal, Dorado, Villar, and Sanz, 2006).

The European Court of Auditors (2018), in a press release, reported that after auditing several PPPs, the deficiencies are notorious as there is no balanced relationship between quality and price with respect to ineffective and unnecessary expenses recorded, lack of transparency in The percentage of risk distribution, which makes some contracts under this PPP scheme a non-viable option to promote public infrastructure works as a response to social problems.

To date, the financial and economic viability of the Wastewater Treatment Plant (WWTP) in Mexico is officially unknown. In this regard, there is no official evidence that shows this situation and reality in the states; Also, there is misinformation transparency and disconnection between studies of financial viability and the social value generated by WWTPs and for which they were promoted and approved in developing countries. Waste is dumped into natural water sources near the urban sprawl, especially rivers, lakes, seas, underground streams, even wasting this resource for drinking water supply, communication as a means of transport, and power generation (Espigares-García, Gálvez, and Lopez, 1986).

The objective of this document was to generate financial viability indicators for the "El Ahogado" WWTP project from the point of view of the developer's investment as an integral part of the water sanitation system in the AMG. Financial viability will be the ratio of financial benefits to financial costs, based on formulas used in a study to analyze financial viability for decentralized sewage treatment plants in Beijing selected because this article focuses on determining whether decision-making for the developer is financially viable and, therefore, its permanence and final results to achieve the objectives proposed by the public sector in the construction, maintenance and operation of the WWTPs object study. Liang and van Dijk (2010) establish that the financial viability of the project will be determined by the relationship between the financial benefits and the financial costs because if the results are less than 1 (one) the investment is not viable, but if on the contrary is greater than one (1), it can be concluded that the work is feasible for its realization and operation.

According to Ordoñez and Losada (2015) point out that water issues have been on the Cooperation for Development Agenda permanently, even several international organizations promote drinking water and sanitation projects from their conceptualization, financing, processes, collection of documented experiences and publications referring to research and manuals on the subject.

For Lahera-Ramón (2010), developing countries such as Mexico must return the water that is used in optimal conditions and after treatment so as not to stop its hydrological cycle, and even they are issues that have not been resolved in part due to the population size, technology, economy, and regulatory policies that have not allowed these projects to be consolidated.

Mexican legislation and institutional

Article 27 of the Constitution of the United Mexican States states that the waters are national and not of the states or individuals; everything originates there, so for this, they defined the national water law that regulates how to manage water in the country, and Jalisco in congruence with the regulatory framework and to regulate the administration of waters in the jurisdiction of the state of Jalisco, the Water Law for the State of Jalisco and its Municipalities was approved, with decree 21804/LVII/06 and published in the Official Newspaper "El Estado de Jalisco" (Congress of the State of Jalisco 2007). This law establishes the regulations and regulatory bases whose activity is to attend to social welfare in terms of water for all state and municipal entities; construction, conservation, expansion of hydraulic infrastructure; administrative cooperation between entities; the provision of drinking water, sewage, sanitation, and wastewater reuse services in the State of Jalisco, delegating responsibility to the municipalities; fees, among others. Regulation of the Water Law for the State of Jalisco and its Municipalities (2009) (Government of the State of Jalisco 2009).

The State Commission for Water and Sanitation (2003) addressed the situation regarding the contamination of natural water sources located in the AMG, mainly in the "El Ahogado" Basin, the Santiago and Verde Rivers, as a result of untreated water spills, to which the Government of the State of Jalisco, with the support of the State Water and Sanitation Commission (CEAS), the National Water Commission (CNA), they promote sustainable alternatives for the environment, protection of the environment, prevention of public health problems and economic engine for projects.

In the "El Ahogado" and "Agua Prieta" WWTP project, the public sector contemplated the participation of private capital in a financing scheme of a Public-Private Partnership in which the Federation through the National Infrastructure Fund (FONADIN) contributes a part of the required investment (49%), while the state is responsible for the difference in missing resources to achieve them. Garrick, De Stefano, Turley, Jorgensen, Aguilar-Barajas, Schriener, ... and Horne (2019) mention that some policies maintain that the administration of public services locally is positive, since the needs are adjusted to the interests of the population, in addition, accountability directly to citizens grows (Herrera, 2014). Mexico registered in 1998 the origin of fiscal decentralization, generating in the thirty-two states. In the legal framework of Mexico, water is a resource for all its inhabitants; that is, it is a public resource and is under the direction of the National Water Commission (CONAGUA), and the reuse of water is regulated. The policies that govern the recovery of water to take advantage of it, for example, in irrigation, make the mandatory administrative costs too high for its use (Mendoza-Espinosa, Burgess, Daesslé, and Villada-Canela, 2019).

In 1992, the WWTPs were the first projects to become concessions in Mexico, a project of the Government of the State of Mexico through the Secretariat of Urban Development and Public Works (SEDOP) (World Bank 2006). Municipalities are responsible for providing drinking water, sewage, and sanitation services, according to article 115 of the Mexican Constitution (Bravo, Castro, and Gutiérrez 2011). Regarding the tariff, issue to demonstrate the financial sustainability of the projects. The National Water Commission (CONAGUA, 2007) points out that there are different models for the rate structure with representative models at the international level and in practice at the national level, which seeks to improve the rate-setting for users; and for the calculation of the rate, the total of the costs that integrate it must be considered "technical, financial and social criteria; these are reflected in the fixed and variable costs" (CONAGUA, 2007, p. 7).

For the particular case of the state of Jalisco, it was determined that the state participation would be covered with resources from private participation through the municipalities of the AMG, which are organized in the Intermunicipal Drinking Water and Sewerage System (SIAPA) for the municipalities of Guadalajara, Zapopan, San Pedro Tlaquepaque, and El Salto; Potable Water, Sewerage and Sanitation System (SIAT), for Tlajomulco de Zúñiga; and finally the El Salto Municipal Potable Water and Sewage System (SIMAPES) for the municipality of El Salto. It has the financial support of the Government of the State of Jalisco, through the State Water Commission of Jalisco (CEA) in the course of the service operation of the work carried out. This situation allows a financing alternative in the face of the lack of economic resources of some of the parties to conclude works of relevance for social benefit.

The results after years of starting these projects have discouraging comments and results, so this document aims to focus its attention on the "El Ahogado" WWTP and review the financial viability for the developer in the face of this million-dollar investment at the initiative of the Government of Mexico, with the projection of monthly income, subsidies regarding the programmed expenses for its operation agreed in the ruling of the Public Tender No. 43111001-046-08 (CEA, 2008), important in this analysis since these must guarantee and demand an optimal result the developer as a member of the private sector in the financial model of the Public-Private Partnership (PPP).

The guarantee of solving public service problems must be contemplated before the start of the projects since these represent a true social impact and hope for problems that afflict several communities. Throughout the document, both treatment plants will be mentioned because they are complementary, and their entire infrastructure forms the integral system of treated water for the AMG.

Anda-Sánchez (2017) points out that the WWTPs mostly used in the municipalities of Mexico consist of conventional or centralized technologies, which demand large amounts of energy, markedly increasing maintenance and operation costs. Unfortunately, when they present failures, they directly impact the communities with sewage flooding. The investment, maintenance, and operating costs are not viable for low-income sectors of the country, as this becomes an unsustainable long-term financial burden for the users or beneficiaries of these populations. Mexico should consider new technologies as an alternative to this problem, such as decentralized wastewater treatment systems (cost reduction, adaptation to the environment for its construction, etc.). On the other hand, the “El Ahogado” WWTP is projected to serve 20% of the AMG, while the “Agua Prieta” WWTP 80%, in order to integrate the wastewater treatment system of the AMG urban area.

Due to the contamination of the Santiago River by residual discharges from the AMG, the construction of the “Agua Prieta” and “El Ahogado” WWTPs was promoted with the support of federal, state, municipal, and private sector resources. The lack of budget at the three levels of Government in Mexico (federal, state, municipal) once again allows the participation of the private sector in investments that promote development in different sectors. These two-infrastructure works form the purification or treated water system, with a projection of sewage treatment of 89% in the AMG. For both WWTPs, the financing model is under the PPP scheme and with a DBOT contract (design, construction, operation, and transfer), with the long-term operation. The sources of investment and characteristics of the projects are illustrated in table 1. Regarding the construction of the sewage system and the collectors, they are carried out by the companies with the best economic and technical proposals under the regime of the Public Works Law, absorbed in its entirety with public resources.

Comprehensive Sanitation Project for the Guadalajara Metropolitan Area			
Details	Public sector	Private sector	
Investment	Sewerage and collectors "Agua Prieta and El Ahogado"	Treatment Plants - PPP Scheme (DBOT) 20 years	
	Construction of: sewerage network 615 km collector system 203 km pumping station San Gaspar collector tunnel San Martín collector	"Dark Water" 8.50 m3/s 80% treated water	"The Drowned" 2.25 m3/s 20% treated water
Tender and Trust		2009 – 2012	2008 – 2009
Expenditure Budget of the Federation (PEF)	USD 88.61 million		
Jalisco state	USD 88.61 million		
National Infrastructure Fund Trust (FONADIN) non-refundable.		USD 45.52 million	USD 19.71 million
Private investment		USD 79.58 million	USD 21.53 million
Subtotal	\$177.23	USD 125.09 million	USD 41.24 million
Total investment without VAT	USD 343.56 million		

Table 1 Characteristics of the Comprehensive Sanitation Project of the AMG

Source: National Water Commission (CONAGUA, 2012) Strategic Projects for drinking water, drainage and sanitation. National Infrastructure Program 2007-2012. De la Pena et al. (2013). own adaptation
The dollar exchange rate used corresponds to \$20.8266 MN MX on March 15, 2022. <https://www.banxico.org.mx/tipcamb/main.do?page=tip&idioma=sp>

The objective of the "Agua Prieta" WWTP project is to provide and take advantage of the reuse of treated water for the generation of electricity for the benefit of the Federal Electricity Commission (CFE), Valentín Gómez Farías hydroelectric plant. Finally, once the treated water is reused, the discharges will be deposited in the Santiago River. For this work, wastewater discharges from the Atemajac Basin (Osorio, San Andrés, and San Gaspar sub-basins) are contemplated, which pass through the Tunnel - San Gaspar - Atemajac to reach the "Agua Prieta" WWTP, treating 80% of the wastewater from the AMG. (State Water Commission - Jalisco, 2012).

The distribution of capital, according to reports from El Informador (2009), estimates that for the construction of the "El Ahogado" WWTP in Jalisco, Mexico, could have reached a cost of approximately 43.22 million dollars, made up of the participation of FONADIN with capital up to 19.70 million dollars in lost funds (49%), and on the other hand, the participation of private capital, of 25% with risk capital and the rest with a loan at the end of the total project. The recovery of 51% of the developer's investment would be generated at the time of the concession through the payments that the Government of the State of Jalisco would make monthly once this work begins operations.

The financial benefits for the PTAR project will be the monthly payments and subsidies that the CEA makes to the investor or developer agreed upon in the resolution of the public Tender No. 43111001-046-08 (public access at the State Water Commission - Jalisco, 2008). The financial costs will be integrated with the total cost of the investment, maintenance costs, and initial operation. See table 2.

Operation Period		Monthly payments at constant prices from September 30, from 2008.				
Year	Month	investment fee	Fee for fixed costs of operation and maintenance	Fee for variable costs of operation and maintenance	Consideration per month	Total project payments
		T1=TIC + T1R	T2	T3		
3 to 19	31 to 222	\$248.22 million	\$97.04	\$85.44	\$430.70 million	USD 82.69 million
19 to 20	223 to 240	\$102.20 million	\$97.04	\$85.44	\$284.68 million	USD 5,124.40 MD
Total of the National Public Bidding project 43111001-046-08 Data in millions of dollars MDD						\$87,820.55 MD

Table 2 Characteristics of the AMG wastewater treatment plants

Source: Own elaboration based on the Public Tender ruling and information collected from the State Water Commission - Jalisco (2008); National Water Commission (CONAGUA, 2012). Data obtained in field interviews.

Note: Values are given at current prices. Operation Period

Monthly payments at constant prices from September 30, From 2008. Conversion to dollar price.

Projection of monthly payments per rate for the "El Ahogado" treatment plant

Given the results obtained with the data worked, those perceived by the AMG community, it will be supported with references and studies that prove them since this work has been in force for more than ten (10) years. Since the proposal of the project for the PTAR "El Ahogado" to solve the wastewater problem for the benefit of the Metropolitan Area of Guadalajara (ZMG) or also known as the Metropolitan Area of Guadalajara (AMG), several changes have been recorded from its structure of initial financing, as government participation, to finally intervene the private sector in the PPP scheme.

The "Agua Prieta" WWTP was built with federal resources from the National Infrastructure Fund (FONADIN) and private resources. This project is expected to benefit 3.5 million inhabitants; this project is the third-largest in Latin America and the largest plant in Mexico; the cost per cubic meter for water treatment is 98 cents, registering as the lowest in the country, with a capacity of 8,500 liters per second; and the PTAR "El Ahogado" with its 2,200 liters per second, will cover the sanitation of around 98% of the residual or black water produced by the ZMG (Government of the State of Jalisco 2014).

Methodology

From the methodological point of view, the criterion of adapting a research object to a retrospective case study for its current application in Mexico is assumed. In the internal order, the methodology is translated into an analysis of financial viability that includes an evaluation of the financial costs that is integrated with the financial benefits (the initial investment, operation, and maintenance costs) with respect to the financial benefit that would be integrated by the income and possible subsidies delivered to the developer periodically (generated by the payment of the users of the different municipalities that participated in the WWTP project, with the "Contribution of sanitation plants" tax with their respective percentages of participation, subsidies) and that received for water recovery per month. Although the reality is different, since the responsibility is assumed by the SIAPA before the developer, this study will be based on the monthly payments agreed in the public tender, which was published by public sector entities with open access and the one collected in Fieldwork.

The relationship between these two factors will determine the viability (if the ratio is greater than 1, it is viable; otherwise, good financial planning was not done). The formulas used to obtain the results are referenced from a study in Beijing on decentralized wastewater treatment plants to understand the regular performance obtained with respect to expected expectations. For the evolution of financial analysis, the relationship between financial costs and benefits will be taken into account, which is calculated with next formulas (3 and 5), source: Liag & Dijk (2010).

$$V_I = V_B + V_M + V_P \quad (1)$$

$$V_{O\&M} = \sum_{t=1}^n \frac{V_t}{(1+r)^t} \quad (2)$$

$$FC_{PV} = V_I + V_{O\&M} \quad (3)$$

$$FB_{PV} = \sum_{t=1}^n \frac{FB_{r(t)}}{(1+r)^t} + \sum_{t=1}^n \frac{FB_{s1(t)}}{(1+r)^t} + FB_{s2} \quad (4)$$

$$R_{FB/FC} = \frac{FB_{PV}}{FC_{PV}} \quad (5)$$

Where:

V_I : Initial investment (land, electrical and mechanical material, pipes, building construction material, etc.).

$V_{O\&M}$: initial operation and maintenance costs

t : time in which the investment was developed.

r : discount rate ρ

n : number of years of the concession

V_t = operation and maintenance expenses of year t

FC_{PV} : Financial cost (total investment and maintenance costs and initial operation)

FB_{PV} : Financial benefits

$FB_{r(t)}$: Income in year t .

$FB_{s1(t)}$: Subsidies in year t

FB_{s2} : Initial investment subsidies

$R_{FB/FC}$: Relationship between financial benefit and financial cost.

For this investment, three rates are agreed upon, classified as follows: T1 investment rate, T2 rate for fixed costs of operation and maintenance, and T3 rate for variable costs of operation and maintenance, which make up the total consideration for the project, listed in table 2.

Results

To achieve the collection of this information, officially published sources with free access were sought, mainly issued by the State Water Commission of Jalisco (CEA), the State Government, SIAPA, CONAGUA, newspapers, magazines located in databases and the Internet, government reports, among others, and as fieldwork, an interview was conducted with government officials from the state of Jalisco. The results obtained show that the financial viability for this project is zero (0.00162366).

These reinforce information issued by the CEA itself, institutions, researchers, and even various government entities, where the monthly payments agreed in the Public Tender rose considerably in the face of maintenance and operation costs.

The information was converted to real prices based on the National Consumer Price Index (INPC) (financial costs, income to the developer, and investments) to determine the financial viability of the “El Ahogado” WWTP. As of November 2009, the initial investment, maintenance, and operation costs were deflated. For its part, revenues to the developer were deflated as of 2012, which is when the commitment begins until 2029. However, as of 2022, an increase in inflation (INPC) is projected based on the increase in the average registered year in 2021. The results obtained are generated based on the information listed in table 3.

Formulas details	Without vat
V1: Initial investment (land, electrical material, pipes, construction material, etc.)	\$19,350,466.43
VO&M: initial operating and maintenance costs	\$5,477,484.51
t: time in which the investment was developed	2.5
r: discount rate	12
n: number of years of the concession	20 years
Vt= operation and maintenance expenses of year t	\$31,661,176.03
FBr(t): Income in year t.	\$42,128,430.21
FBs1(t): Subsidies in year t	\$0
FBs2: Initial investment subsidies	\$0

Table 3 Information for the calculation of formulas
Source: State Water Commission - Jalisco (2003). Data obtained in field interviews. Minutes of the Public Tender decision and information collected from the Jalisco State Water Commission – CEA. (2008). Deflated data (real own prices obtained) based on the National Consumer Price Index INPC. Base = 100 second fortnight of July 2018

The results obtained are the following:

$$FB_{PV} = \text{USD } 1,714.28$$

$$R_{FB/FC} = 0.00162366$$

Given that the final relationship between financial benefits and financial costs is less than one, it is concluded that it is not financially viable from the developer's point of view, which allows reinforcing the results with literature that addresses comments against expectations. Expected before this millionaire infrastructure work in the AMG. Construction of the “El Ahogado” WWTP began in 2012 to complete the sanitation of wastewater from the AMG on a par with the “Agua Prieta” WWTP, but the proposed objectives have not been achieved due to the lack of pipelines to handle the municipal discharges from Tlajomulco since the wastewater from this municipality falls directly into the Santiago River, notoriously affecting this water resource of the state for the development of important economic activities in this region (Government of the State of Jalisco 2019).

Contrary to the amounts reported in the final decision of the Public Tender No. 43111001-046-08 (State Water Commission - Jalisco, 2008), which amount to USD 430,709.09 thousand dollars per month, Anda-Sánchez (2017), addresses the high maintenance and operation costs for the “El Ahogado” WWTP, where monthly it is for USD 1,632 thousand dollars, becoming a long-term and non-viable debt for developing countries.

Some exercises were carried out to understand that in the absence of subsidies from the beginning of the investment and in the years granted to the developer, the relationship becomes negative; On the contrary, if these are present during the initial investment and in the concession years, the relationship is positive, yielding a result greater than 1. But this analysis can be supported if the monthly payments reported and agreed in the accepted public tender have been fulfilled, in contrast, with the results shown in the information collected.

Meléndez (2020) comments that the “El Ahogado” WWTP is overflowing because it is working at 110% of its capacity; it is attributed to the increase in population but adds the same CEA that the “Agua Prieta” WWTP is not working at its capacity maximum after three years of operation since it is only at 56% of its capacity.

This confirms that the project of the two largest treatment plants is not complying with the attention to the pollution problem, a statement issued by the Greenpeace organization according to a November 2016 report, since in their studies they found highly toxic, unregulated chemicals by Mexican Law, they also conclude that these plants will not solve the problem, since they only treat domestic water and were not designed for industrial discharges.

Covarrubias and Lozano (2012), in their article "The plant of "El Ahogado", the last fiasco of Calderón," strongly evidence how political interests are more relevant than social welfare problems. This is demonstrated by the million-dollar approval of the PTAR "El Ahogado" to attend to the sanitation of the Santiago River, where the norms of NOM 001-SEMARNAT-1996 are not fulfilled in 87% to 94% by the industries located mainly in the municipality from El Salto, precisely where the "El Ahogado" dam is. The high levels of substances were found to violate the provisions of the Federal Water Rights Law 2009 (Secretariat of Environment and Natural Resources 2009). Between El Salto and Juanacatlán, the mortality rate from 2007 to 2010 increased due to diarrhea, gastroenteritis, malignant tumors, leukemia, cancer, hypertensive kidney diseases, among others, according to the National Health Information System (Sinais). On the other hand, the problem is exacerbated by irresponsible administrations such as the PRI and the PAN, where an average of 23 housing developments were authorized a decade ago. In an interview with the Greenpeace organization, the Mexican legislation for the regulation of the environment is obsolete, and they are free for the industry. He concludes that those who pollute are the industries that cause the contamination, such as the case of non-phenol, since there is no technology in the world to clean this substance, so its implementation should be prohibited.

It is concluded that the project was not analyzed from the beginning because these plants were only going to attend to domestic water discharges, so the real beneficiaries are the developers in the face of the millionaire charges, as researchers from the Western Institute of Technology and Higher Studies (ITESO) (Covarrubias and Lozano, 2012), they already knew that these WWTPs were not going to solve the problem because they did not address the real problem by applying the technology required to attend to the water discharged by the industries.

In more recent information, Beret (2020) reports that the "Agua Prieta" WWTP is underutilized according to the report of the 2014-2018 Institutional Plan of SIAPA (National Water Commission (CONAGUA, 2016), in the absence of collectors, highlighting that the capacity of the project proposal of 8.5 m³/s, only 5.4 m³/s are working on average. The promise of the state government to treat up to 89% of the AMG has not been fulfilled because the results in 2019 are 51. Given this situation, SIAPA, from the Tariff Commission, published that, for the wastewater treatment activity, the monthly fee will be between USD 0.03 cents and up to USD 0.50 dollars.

Meléndez (2020), according to reports requested for transparency, the CEA informs that due to the new investment in the infrastructure of another 13 treatment plants within the state with an estimated USD 28.81 million dollars will partially solve the contamination problem by managing to go from 65% to 70% of sanitation of the domestic waters that fall into the Santiago River. The questioning that is made in this report to the Government is towards the wrong solutions that are being implemented to this problem; according to Cindy McCulligh, a scientist from the University of Zacatecas, points out that the eastern interceptor collector or tunnel that conducts wastewater from the AMG should be built to the "Agua Prieta" WWTP, which has been contemplated since 2013. The tunnel project has not even been put out to tender to date, but it is contemplated from the projection of the wastewater treatment system for the AMG specifically for the "Agua Prieta" WWTP project, so this sewage in part of industry and farmers are going directly to the Santiago River through the municipality of Tonalá when going down the ravine.

Discussion and conclusions

The approach that was carried out in this study allows us to conclude that for the financial conditions for the development or private capital in the “El Ahogado” treatment plant project, it was not financially viable given the maintenance and operation costs required in this infrastructure. This is reinforced by the monthly payments that the Government of the State of Jalisco must currently make through CEA to the developer since they are notoriously higher than those proposed in the public tender.

These results strengthen the comments recorded in the literature and research against millionaire investments, which are approved without a guarantee against the proposed or promised results. In addition to this, it is once again demonstrated the lack of experience on the part of the public sector to carry out infrastructure works for social benefit without generating long-term indebtedness and making the provision of public services more expensive.

It has been shown in some studies that decentralized WWTPs can be an alternative to contaminating the state's water basins and water resources, but this would go against policies that protect companies and large monopolies already established in the AMG. If real estate developers, industrial complexes, shopping centers, and works that constantly generate waste or sanitary waste were approved to build their own WWTPs, in exchange for subsidies or discounts in their rates for the payment of services, the pollution of rivers and water sources could gradually recover. The literature review allows us to appreciate that the Mexican legislation to protect the environment is obsolete and leaves an open gap for the indiscriminate use of industries, for not typifying the use of chemical substances harmful to life and that their use should be prohibited not only in Mexico but in the whole world. Likewise, the permissiveness and negligence of governments at all levels, by not controlling wastewater discharges from chemical processes; the deception of the population for electoral purposes in many cases, by allowing million-dollar works that do not solve the pollution problem with technology aimed at industrial waste. To this must be added the indebtedness and long-term economic commitments to which citizens and future generations are exposed.

Although the results obtained in this investigation are relevant from the financial point of view, the operation of the WWTP requires continuing to analyze the cause of the problem to really solve the wastewater treatment. It is considered necessary to continue with the analysis to include the positive externalities, social, and economic impact to validate the legitimacy of the millionaire investments made by the governments. The experience that the development companies have should be evaluated for more objective purposes so as not to cast doubt on their results with significant investments from the public sector.

The Law of Public-Private Partnerships of January 12, 2012, states that the works under these contracts must be directed to social benefit and demonstrate the advantages of this financial scheme in comparison to other forms of financing, but in practice, it can be concluded that there is a lot of inconsistency when obtaining the results. This can be supported when submitting proposals in public tenders because in this case study, the technology to treat wastewater from the AMG did not address the real problem of contamination of the Santiago River due to not carrying out in-depth studies or because the important thing is to obtain the ruling in favor of the developer presenting the lowest proposal with very high expectations, but that in the inter-years of the concession the agreed payments increase substantially, without this guaranteeing the solution to the real problem. It is the bidders who submit proposals, initial investment costs, financial, maintenance and operation costs, delivery times for their operation, environmental impact studies, financial and social feasibility, among others, to achieve the objectives.

The issue of conserving water resources in the state, and very possibly in the country, has become an issue of proselytism, of permits to the industry, to real estate developers, to agribusiness industries, regardless of the cost of living and irreparable damage to the environment. The most viable solution that the Government sees in its different instances is to raise the tariffs for the use of water to the consumer, but the references mentioned here show that the problem is not the high tariffs, nor the subsidies, but rather the infrastructure in its total construction.

It is necessary to promote a change of vision for the public sector in the face of the responsibility to attend public services for the well-being of its inhabitants with public works that guarantee their purpose and where the private sector participates with the same interest, and even strictly regulating compliance and the payments agreed upon in public tenders. In addition, it is necessary to promote and typify the use of decentralized WWTPs, where they are adapted to developments and projects approved under national and international laws; that is, each developer must generate their own WWTPs and be responsible for the waste produced. Current investments with conventional WWTPs can only serve to treat residual or domestic waters due to their initial nature for projects. Without a doubt, it is extremely necessary to promote international laws that do not allow countries to deliberately choose the systems they consider suitable for treating wastewater, changing the view that water resources belong to all of humanity.

The recovery of natural sources such as rivers, lakes, dams, among others, are issues that today acquire relevance for developing countries, with the construction of an entire infrastructure for channeling wastewater to be treated in wastewater treatment plants. The responsibility to invest in these projects is of the governments to attend to this problem; however, the responsibility to cover the obligations for the use and exploitation of drinking water, as well as that which is wasted as organic waste from personal property, is undoubtedly of the citizens, the main characteristic of the services is that whoever uses them pays for them.

The criterion of financial viability for the developer is assumed based on the comprehensive sanitation project in the AMG. This research not only intends to throw a number to determine the financial viability based on the developer, but also contextualizes the value of water and the responsibility assumed by both private actors and the public sector for decision-making to make financial alliances, and with this, solve social or infrastructure problems in favor of national development. It is suggested to continue with studies that show the responsibility of the developers before the obligations acquired in the failures of the tenders against the results of the works and close the biases in indiscriminate payments and far from those accepted in said tenders.

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