ISSN: 2047 - 0398
SPECIAL ISSUE – VII|4|N|12| May | 2015

ENVIRONMENTAL EVALUATION: Case Study of Project Selection

Mariano Yoshitake, Dr. (PhD) (*Corresponding author*)
Faculdades Alves Faria- ALFA, Goiânia, Goiás, Brasil.
E-mail: *kimimarinamariano@gmail.com*

Joao Eduardo Prudencio Tinoco, Dr. (PhD)
Faculdade Campo Limpo Paulista-FACCAMP, Campo Limpo, São Paulo, Brasil.
E-mail: *tinocojoao@uol.com.br*

Patrícia Schneider Severo – Master (MsC)
UNIPAMPA - Universidade Federal do Pampa, Bagé, Rio Grande do Sul, Brasil.
E-mail: *patriciassevero@hotmail.com*

Robson Borges Salazar – Master (MsC)
Faculdades Alves Faria ALFA), Goiânia, Goiás, Brasil
E-mail: *salazar@saneago.com.br*

Marinette Santana Fraga, Master (MsC)
Universidade Federal de Juiz de Fora, Juiz de Fora, Minas Gerais, Brasil.
E-mail: *marinettefraga@gmail.com*

ABSTRACT

The purpose of this article is to verify that the methods of economic valuation of the environment constitute a viable alternative for choosing projects that result in environmental gains. Specifically, the study is based on the contingent valuation model (CVM) used to economically evaluate the Willingness to Pay (WTP) for the environmental benefits applied to a case of a sanitation company. We used descriptive research by identifying the economic evaluation methods applicable to basic sanitation projects and economic valuation methods of the environment. The results show that the incorporation of the economic value of the benefits generated by the project, by calculating the WTP by secondary treatment, obtained by MVC, is economically and socially viable, when the Net Present Value (NPV) becomes positive, the rate Internal Return (IRR) exceeds the hurdle rate and the relationship Index Benefit-Cost (B / C) is greater than one.

Keywords: *Environmental assessment methods; Sanitation; Willingness to pay; Contingent valuation*

1. INTRODUCTION

The application of environmental valuation methods in the evaluation of projects has become increasingly common over time, as new methods are developed at the same time there are new interpretations to solve problems.

Some national and international organizations have acted as encouraging the use of methods of environmental valuation as a model stop to measure in economic terms, the impacts from the project implementation, especially those related to sanitation. The government projects necessarily produce benefits for society, unlike the private sector.

The universal service does not necessarily bring improvement in social welfare due to the improvement of the environment. The Sanitation Company of the State of Goiás (SANEAGO) measures the economic sustainability through strict methods of private analysis, which in turn incorporate only the costs for realization of investments and the net benefit of charging fees less costs to operation and maintenance of systems.

This practice is part of a strategy of governments for becoming autonomous companies and ability to make investments to expand the services that due to the scarcity of these resources, the company gives priority to those with the greatest economic viability. From this contrast, the stimulus appeared in researching more elaborate evaluation methods that take into account situations of public interest, contrary to what is considered when evaluating projects private interest, in order to achieve sustainability.

From this perspective, Aligleri, Aligleri and Kruglianskas (2009, p.16) show that "to the extent that the company becomes involved with a business model that evaluates the consequences and impacts of their decisions and actions as well as financial analysis, contemplating social and environmental aspects, it is committed to tomorrow and thus to sustainability."

In this context, the research problem of the article is to verify that the methods of economic valuation of the environment constitute a viable alternative for choosing projects that result in environmental gains.

Specifically, the objective of the study is to evaluate the incorporation of the contingent valuation method (CVM) is part of the economic and financial evaluation model used by the Sanitation Sector Modernization Program (PMSS). The MVC is used to economically evaluate the Willingness to Pay (WTP), the environmental benefits of sanitation investments, applied to a case example of a sanitation company.

We used the economic evaluation methods applicable to urban infrastructure projects in sanitation, exploratory and descriptive research also qualitative. Exploration at the time did a survey and identification of economic evaluation methods applicable to urban infrastructure projects in sanitation and economic evaluation methods of the environment. Descriptive because we used a case-example (Roesch, 2005) involving a project from a utility company to provide public services of water supply and sewage.

The information is drawn from company documents analyzed, such as the work budget, which contains information about the investment required for its implementation, operational data information system, from which you can extract the information about the cash flow generated by the project. The estimated parameters resulting from that survey, resulting in 1,064 observations for the city of Goiânia were used, these variables, the t-student statistical averages and coefficients.

We also used procedure for restatement of variables search parameters (price for sewage treatment and family income), through the Consumer Price Index (CPI) published monthly by the Brazilian Institute of Geography and Statistics (IBGE), considering the base date in July 1996, until the update date in July 2009, corresponding to the last project budget date.

The methodology for the economic evaluation of the sewage treatment project followed the model adopted by the PMSS, with the use of spreadsheets in MS Excel 2007 software, in order to calculate the IRR, NPV and cost-benefit ratio, incorporating the benefits of contingent valuation method to this economic evaluation.

2. FUNDAMENTALS OF RESEARCH

In terms of Barde (1995 apud Tolmasquim, 1995), the development of techniques of valuation in monetary terms of the environmental problems and its application of cost-benefit analysis, is one of the directions given for the development of environmental economics.

According to Maia et al (2005), the various existing methods of assessing the economic and financial viability of projects can be classified into two categories. The first groups the methods that apply rules of thumb, not based on the concepts of efficiency, called "finger of rules." The second is consistent with the fundamentals of economic theory, based on the estimation of consumer demand function and the surplus for the assessment of economic and social viability.

Following this reasoning, Aguirre and Faria (1996) complete that in the case of projects that are intended to produce goods that do not pass through the market, we use the contingent valuation method (CVM). These clarifications Aguirre and Faria were put in place by the Sanitation Sector Modernization Program (PMSS), currently under the Ministry of Cities, when in 1998 he edited the Economic Assessment Methodology and Financial Projects.

The basic principle of this methodology raised by Moita et al (1998), points out that sanitation services are essential and therefore are a requirement of society. These services are aimed large investments with significant participation of public resources. Therefore, the detailed knowledge of the needs of society and the design of optimal alternative of choice are essential for the optimization of these resources, given an order of priority in order to maximize the welfare-social.

Analyzing the behavior of poor nations Ayach et al (2012, p.4 and 5) state that: “despite numerous discussions about the importance and the interrelationships between sanitation, health and the environment, there is, at present, even with the remarkable technological advancement, a notable absence of planning and environmental valuation

and due quality facing infrastructure and services targeted for the sanitation sector, with the lower social classes the hardest hit, as one might even predict".

The aspects mentioned by Ayach et al (2012) imply challenges that must be faced, as clearly explained in (BRASIL, 2007, p.11). Investment in sanitation is the only way to reverse the existing framework. Data released by the Ministry of Health state that "for every $1.00 (one real) invested in the sanitation sector, saves up R$ 4.00 (four dollars) in curative medicine area (BRASIL, 2007, p. 11).

In this regard, Leoneti et al (2011), based on Toneto Junior (2004) emphasize that the preservation of waters by sanitation and sewage treatment stations have applications including: sports fields irrigation, squares; landscape uses; street cleaning, etc. Moreover such alternatives, according to the authors, contribute to the reduction of drinking water for the above purposes, in addition to generating positive externalities on health and the environment.

It is inferred that there is an urgent need for the global community - public and private sector - to unite to take on the challenge of protecting and improving water quality in our rivers, lakes, aquifers and faucets. Leoneti et al (2011, p.1) in this regard showed that: From the 1950s until the end of the last century, investment in basic sanitation in Brazil occurred occasionally in some specific periods, with an emphasis on the 1970s and 1980. As a result, Brazil is still marked by great inequality and deficit access, particularly regarding the collection and treatment of sewage. Currently, the industry has received greater government attention and there is a significant amount of resources to be invested. (LEONETI et al, 2011, p.1).

Complementing Aguirre and Faria, Moita et al (1998) point out that this environmental assessment methodology consisted in the economic evaluation of the social point of view, in order to assess the attractiveness of the project for the economy as a whole, incorporating the externalities of the project differing substantially from traditional financial analysis (private analysis), because it considers the costs and benefits in shadow prices and the economic benefits achieved through the Willingness to Pay (WTP).

Furthermore, in accordance with the words of Aguirre and Faria, other researchers including Individual and Pessoa e Ramos (1998, p2) observed that: the contingent valuation method (contingent valuation method) - CV - is based on the revelation of consumer preferences through questionnaires that seek to capture the arrangements to pay for the use or preservation of an environmental good, and the provisions receivable from asset loss if it undergoes a process of destruction or degradation.

The return of analytical techniques for investments in sanitation projects, such as Net Present Value (NPV), Internal Rate of Return (IRR) and the benefit-cost index (B/C), are presented and illustrated within the This case study.

3. CASE STUDY: Sanitation Projects

Context of the Sanitation Company of the State of Goiás

The SANEAGO was established in 1967 by the Government of the State of Goiás through the transformation of the State Department of Sanitation in mixed company, having assumed the duties of the department concerning the provision of sanitary sewer services and water supply.

In day to the 06 e July 7, 1996 was held one pilot study to test the questionnaire and train researchers through 220 interviews for the study component. Focus groups selected the target population were defined through discussion by the community of the problems that the project is intended to address, as well as the definition of WTP values entered in field research.

Table 1 - Number of interviews by income – Goiania, State of Goiás – July 1996

Income Range	**Nº of Interviews**
Up to 02 Minimum Wage	712
From 02 to 05 Minimum Wage	449
From 05 to 10 Minimum Wage	216
De 10 a 20 Minimum Wage	109
Above 20 Minimum Wage	61
Total	**1.547**

Source: "Ampla Visão Assessoria e Serviços" - Field Research - July / 96.

Specifically to measure the benefits of the implementation of Goiânia Sewage Station, were interviewed in 1064 heads of families. It was found that almost all were working and this time the family income was R $ 1,095.43 and there was also that the income of the household head accounted for nearly two-thirds of family income and this, in time, had on average 4.09 people of which 2.04 worked. (SANEAGO, 1997).

The value of the minimum salary at the time of the completion of fieldwork, had a face value of R $ 112.00 (one hundred and twelve dollars), the average value of the observed monthly family income represented a value of 9.78 minimum wages in However, in the face of real increases in the minimum wage of recent years, we have updated the value observed by the CPI, published by IBGE using the following equation:

Vr = Vn x update factor Equation (1)

where:

Vr is the adjusted value;
Vn is the nominal value of the monthly income of the household head observed on the base date of the survey (July / 96).

Update factor is the CPI by the correction factor between the base date and the date of update (July / 2009), this factor showed the value of 2.237917. Thus, it was observed that the value of the adjusted family income, corresponds to R $ 2,451.48 or 5.27 times the minimum wage in the update date, this amount shall be considered in the economic evaluation. The average age of respondents was forty-two years and the main characteristics of the people interviewed are arranged in Table 2:

Table 2 - Characteristics of the population interviewed

Feature	**% of Total**
Males	51%
Females	49%
Education	
- Inschooled	6,2%
- Primary	43,4%
- Middle Level	32,4%
- Higher Education	18,0%
Type of House	
- Building home	94,8%
- Apartment	5,0%
- No specifications	0,2%

Source: Prepared from SANEAGO, 1997.

The preservation of the Meia Ponte River and the fact of it to serve part of Goiania water supply were the main factors for accepting the payment for sewage treatment, as can be seen in Table 3:

Table 3 - Reasons for accepting payment - Goiânia / 1996

Reasons for accepting payment	**Frequência**	**%**
Preserving the environment	329	53,2
The river is a source of water supply	110	17,8
The work is of interest	88	14,2
Rate value is reasonable	66	10,7
You have practiced sports in the “Meia Ponte” River	11	1,7
Other	10	1,6
The house is near the river	5	0,8
Total	**619**	**100,0**

Source: “Ampla Visão Assessoria e Serviços” - Field Research - July / 96.

As detected by field research, the refusal to the willingness to pay (WTP) in just under half of the respondents, was in large part by the payment of transfer of responsibility for these, the government is who should pay, another reason alleged in almost a third of respondents is that already pay a lot of taxes, for other reasons had lower participation, as can be seen in Table 4:

Table 4 - Reasons for refusal to pay - Goiânia / 1996

Reasons for refusal to pay	Frequency	%
Rate value is high	51	11,5
There is no interest in the work	15	3,4
Does not accept to pay	11	2,5
Do not believe it do the work	34	7,6
The work will not work well	06	1,3
Pay many taxes	124	27,9
Government should pay	191	42,9
Other	13	2,9
Total	445	100,0

Source: "Ampla Visão Assessoria e Serviços" - Field Research - July / 96.

The results were presented by calculating profitability indicators resulting according to some private enterprises evaluation criteria presented in the theoretical framework from the cash flow, comparing investments, with the revenues and costs generated by the project, are they : IRR, NPV and Index B / C.

Provision of calculation to pay (WTP) for the benefits of PST

The utility function representing the choice between the three studied alternatives, ie, system maintenance only collection, implementation of a plant to sewage treatment (PST) in the primary phase and implementation of a WTP for treatment in primary and secondary stages, follows the model presented by Motta (2006) is given by:

$$V_{js} = \alpha_{js} d_{js} + \gamma_s d_s + \beta(y - p_{js}) + \eta_{js} \qquad \text{Equation (2)}$$

where:

djs is a dummy variable with value 1 for secondary treatment;
ds is a dummy variable with value 1 for any type of treatment;
pjs is the price of each alternative;
y is the family income;
ηjs is a stochastic variable that captures unobserved variables.

The data presented here refer only to the calculations and results for the assessment of willingness to pay (WTP) the benefits derived from secondary treatment, used in the evaluation of the expansion project of Sewage treatment plant (STP) of Goiânia, and omitted all the steps and results about the other benefits raised by field research. Moreover, for calculating the secondary treatment WTP were analyzed using discrete choice models (discrete choice) and logit model. Although the results presented in the first model to have reached higher values for willingness to pay, they were not presented in this paper due to the discrete choice model was not discussed in the theoretical framework, therefore, was used to evaluate only the results obtained the logit model. Along these lines, Aguirre and Faria (1996) explain that the linear probabilistic models are simpler to be computed, however estimators have its bias, while the probit and logit models are more practical because they use accumulated probability function in similar ways and produce similar results. From this viewpoint, the design SANEAGO (1997) demonstrated the equation 3, in the case of binary patterns in referendum model to calculate the probability of an individual to choose the secondary treatment, since P (j = 1 / s = 1), since which opted for the treatment of sewage.

$$P_{(j=1/s=1)} = 1 / (1+e^{(-\alpha_{11}+\beta\Delta(p_{11}-p_{12})})) \qquad \text{Equation (3)}$$

Averages are of secondary treatment for WTP were obtained from the indirect utility function shown in equation 4 is given by:

$$WTP(\text{Trat. Sec}) = (\alpha_{11} + \gamma_1) / \beta \qquad \text{Equation (4)}$$

It is inferred that the best representative mathematical function of DAP where α is the intercept, γ and β estimators income parameters (y) and price (p) respectively, represented in the equation 5:

$$\Delta V_{js} = \alpha + \gamma LNy - \beta LNp \qquad \text{Equation (5)}$$

Finally, to the restatement of the results obtained from the survey conducted in July 1996, we used the CPI and the correction factor applied to the nominal value, as shown in equation 1.

From the field survey conducted in 1,061 econometric model and observations contained in SANEAGO program (1997), can be summarized results presented in Table 5.

Table 5 - Model results for secondary treatment

Model	Variables	Coefficients (Statistics "t"	Averages	WTP (R$)	WTP Up to date (R$)
Logit	Constant Total income Ln price	0.17086 (1.094) 0.00020 (4.165) -0.72135 (-8.826)	- 1095.4 1.7524	1,71	3,83
Logit (considering only 141 families living near the river Anicuns)	Constant Ln Price Constant Distance to the river Price	0.75908 (1.659) -0.88621 (-3.625) 0.80473 (1.952) -0.00034 (-1.838) -0.17123 (-3.669)	- 1.8261 - 1224.0 7.8801	2.35 2.21	5,26 4,95

Source: "Ampla Visão Assessoria e Serviços" - Field Research - July / 96.

For this model, we estimated the value of the WTP for secondary treatment at R$1.71 per month per family, whose value corrected for July 2009 increased to R$3.83 by applying the correction factor by the CPI. Substituting the coefficients found in the formula 5, we have that the variation of the secondary treatment benefits is given by:

$$\Delta V_{js} = 0{,}17086 + 0{,}00020LNy - 0{,}72135LNp \qquad \text{Equation (6)}$$

Where:

ΔV = change in well-being with the secondary treatment of sewage
Income = monthly family income (R$ / family / month)
Price = price of the treatment of sewage

In simulation, considering only the 141 families surveyed, who lived near the river in trouble, it was observed that there is a greater willingness to pay for secondary treatment estimated at R $ 2.35 per family / month whose value adjusted by the CPI becomes R $ 5.26 and this arrangement reduces to the historical value of R$2.21 or US$4.95 corrected by the same criterion established, as the distance from the house to the river increases, which can also be explained the negative sign of the coefficient "distance to the river" presented in Table 3, for the same sample.

Based on that in the economic evaluation are considered as project beneficiaries persons born in Goiás (goianiense) population, we used the first simulation results to estimate the resulting price of WTP by secondary treatment, as shown in equation 6 number.

So it was possible to determine the price through the number of formula 7, given by:

Price = e ((0.17086 + 0.00020LN Income) / - (- 0.72135)) – Equation 7

The WTP value of R $ 1.72 Family / month found in the original research results from the replacement of the average monthly income of R$1,095.40 seen in field research on which has not been given its Ln as expressed in the equation (7). There was the necessary adjustment, that is, applying the Ln on the average income, the value of WTP found becomes R$ 1.27 Family / month.

Considering the value of WTP corrected by the CPI, applying on this correction factor, as equation number 3, came up the price of R $ 2.84 on the base date of July 2009, which was the value of the additional benefit unit the implementation of the expansion project of Sewage treatment plant (PST) at Goiania for secondary treatment, considered in the economic evaluation.

4. ECONOMIC AND FINANCIAL EVALUATION

We used the economic and financial evaluation model used by Sanitation Sector Modernization Program (PMSS) in Microsoft Excel software through linked sheets together.

In the first stage of the review process, according to the model used by the PMSS, there was a survey of demand and supply, through spreadsheets, including general data, as shown in Table 6, and data were obtained from management reports available in SANEAGO:

Table 6 - General data

Analyzed alternative:	**Without Project**
Base year	2009
Population in the project area in the base year	1.273.514
Population growth rate	1,78% ao ano
Number of persons for economy:	3,17
Water consumption per capita (l / h / d) (not including losses)	174,5
Non-residential consumption (as % of residential):	14%
Billed volume without water meter for economy (m3 / month)	10
Relationship economies / link	1,39
Number of people per connection:	4,41

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

The general data collected for the situation "with project" have not changed since it was only analyzed the expansion project of the primary treatment system for secondary, without increasing the volume of treated wastewater, whose flow was set at 3.1 m3 / s as current capacity.

Table 7 - Summary of the population served

Period	Average Population Total	Average links residential	Average Population Served	Percentage level of service
Interval	(A)	(B)	(C)	(D)= (C)/(A)
2009 - 2039	1.693.367	305.033	1.311.513	77,45%

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

As shown in Table 8, the demand for sewage collection was calculated as the volume of water consumed, a discharge coefficient of 0.76 of this volume and infiltration rate in the transportation of effluents 1.1. It was also compared the system transportation capacity relative to demand, revealing the difference between capacity and demand.

Table 8 - Supply and demand

	YEAR	
	2009	Média 2010-2039
Transport capacity (Interceptor) in ((Thousand M3)	97.762	97.762
Water Consumption (Thousand M3) – Residential	62.823	86.758
Water Consumption (Thousand M3) – Non residential	8.795	12.146
Water Consumption (Thousand M3) - Total	71.618	98.904
Download coefficient	0,76	0,80
Coefficient of infiltration, networks, collectors and interceptors	1,10	1,10
Demand for Wastewater Collection	59.873	87.036
Difference of Existing Capacity and Required Capacity (Thousand M3)	37.889	10.726

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

It was assumed also that the implementation of the project, and no reported increase in production capacity, also did not incur increased rate, therefore there is no impact on the average daily consumption used in the analysis, due to the price elasticity even being observed with respect to income elasticity, which for purposes of analysis remained constant.

5. ANALYSIS AND DISCUSSION OF THE RESULTS

The evaluation model raised the necessary information to build the incremental cash flow by raising revenues and costs of the "no project" and related to investments required to project implementation (with design), maintenance and replacement, for subsequent application of deterministic methods of private analysis.

Table 9 - Summary of Total Revenue

ELEMENTS	**AVERAGE BETWEEN 2009 - 2039**
Billed Volume (Thousand M3) Residential	2.578.796
Billed Volume (Thousand M3) Non Residential	361.022
Billed Volume (Thousand M3) Total	2.939.827
Average Tariff Sewage Collection - R$ / M3	1,60
Collection Efficiency (%)	96%
Total Revenue (US$ Thousand)	4.515.574

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

Table 9 showed the total revenue from the rendering of services, without the project. This was calculated as the volume of water consumed, the average tariff collection and treatment of sewage, in the estimated amount of R $ 1.60 which corresponds to 80% of the amount charged for water tariff and average efficiency of collection SANEAGO which averaged 96%, according to the management reports of the company seen throughout economic horizon of the analysis.

As model adopted by the PMSS, it was necessary to survey the initial investments in the implementation of the project, broken down into: a) unskilled labor; b) skilled worker; c) domestic materials; d) foreign materials; e) national equipment; f) foreign equipment; g) transport; and h) taxes, as shown in Table 10.

Table 10 - Initial investments (in thousands of Reais - R$)

Type of Investment	Qualified Labor		Materials	Equipments	Total Costs	Taxes	Total General
	No	Yes	Nationals	Nationals			
Purchase of lands	o	o	o	o	o	o	o
building connections	o	o	o	o	o	o	o
interceptors	o	o	o	o	o	o	o
Collectors networks	o	o	o	o	o	o	o
Emissaries Final	o	o	o	o	o	o	o
Subtotal Investment	17.054	1.646	16.896	32.037	67.633	16.593	84.225
Cost projects	0	0	0	0	0	0	0
Cost supervision	0	569	0	0	569	221	791
Contingency reserves	0	0	0	0	0	0	0
Total Cost	17.054	2.215	16.896	32.037	68.202	16.814	85.016

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

From the data recorded by the month of July 2009, estimated the value of R $ 195.17 related to the annual costs for maintenance of a sewer connection, this estimate include taxes, but the same cost without taxes shall be R $ 161.99. Of these costs, 10% were inferred by hand-unskilled labor, 20% of skilled labor, 7% in costs of materials, 60% in domestic equipment and 3% of transport cost, this figure also includes spending relating to the depreciation of equipment and can be summarized in Table 11.

Table 11 - Summary of maintenance costs of a sewer connection

Component	**Participation**
Unskilled labor	10%
Skilled labor	20%
Materials	7%
Domestic equipment	60%
Transport costs	3%
Total	**100%**

Source: drawn from the balance sheet of synthetic SANEAGO / 2009.
Based on the framework of the information 12 was possible to infer values for the annual costs in the "no project":

Table 12 - Summary of additional investment costs (without projects)

Year	Qualified Labor		Materials	Equipments	Freight	Total Costs	Taxes	Total Costs and Taxes
	No	Yes	Nationals	Nationals				
2009	0	0	0	0	0	0	0	0
2010 a 2039	108	215	70	646	32	1.071	219	1.290

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

Figures for the additional investments were discounted to present value at a rate of 7% per year, with a value of US $ 10.764 million for the whole period analyzed, for the "no project", considering the complementary investments in the situation "with project" there was an increase of about US $ 1.812 million from the completion of the project, related to the depreciation of the works and deployed new equipment.

The total costs of operation and maintenance refer to expenses related to the operation of services. The breakdown of these costs is similar to that provided in the initial investment; however, different proportions for hand labor were adopted, as Table 13:

Table 13 - Total costs of operation and maintenance (situation without project in R$ thousands)

Years	Qualified Labor			Chemicals Products	Energy	Total	Total
					Electrical	Economic	Financial
	No	Average	Superior	Nationals	Elétrica	Econômico	Financeiro
2009				3.686	1.793		
2010	7.746	2.450	2.540	3.686	1.793	18.214	22.671
2011	7.884	2.493	2.585	3.686	1.793	18.441	22.957
- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
2039	12.921	4.086	4.237	3.686	1.793	26.722	33.385

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

The present value of total costs of operation and maintenance during the economic horizon for the "no project", presented a profit of R$257,511 thousand for the total cost economic and R $ 320.952 million for the financial value.

For the situation "with project" inferred an increase of personnel quantitative due to the expansion of services, which resulted in an increase estimated at 5.69% of the cost of labor; increased consumption of chemicals for secondary treatment, which impacted on estimated increase of 85.55% in spending on this component, and increased estimated at 5.10% of energy expenses, the results of which are shown in Table 14:

Table 14 - Costs of operation and maintenance (situation with project in R$ thousands)

Years	Qualification of Direct Labor			Chemicals Products	Energy	Total	Total
	No	Average	Superior	Nationals	Electric	Economic	Financial
2009	7.611	2.407	2.496	3.686	1.793	17.991	22.391
2010	7.746	2.450	2.540	3.686	1.793	18.214	22.671
2011	7.884	2.503	2.543	7.371	1.900	22.201	27.375
- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
2039	13.915	4.417	4.488	7.371	1.900	32.092	39.830

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

The simplified economic evaluation or short-cut, was performed by the incremental cash flow resulting from the difference between the investment costs and revenues generated by the situation "with project" and "without project".

It was observed that the implementation of the expansion project for secondary treatment causes no increase in revenues, as the company charges a one corresponding rate to 60% of the water tariff for sewage collection and 20% of that rate by treatment services sewage, regardless of the type of treatment received.

For the implementation of secondary treatment is necessary an initial investment of $ 85,016,000 and the cost increase resulting from this new service, for vegetative growth are negligible. Moreover, there was an increase in operating and maintenance costs obtained by the difference between Table 13 and 14.

The results raised allow you to build a picture of the situation of the incremental revenue and cost due to the short-cut analysis, ie, the simplified analysis that considers the economic benefits identical to financial and costs obtained by subtracting taxes and adding subsidies, which were considered in the order of 50% according to the premises of Sanitation Sector Modernization Program (PMSS) evaluation model, as shown in table 15.

Table 15 - Summary of incremental situation (in R$ thousands)
-Investment Incremental Costs, Operating and Maintenance

Years	Total Income	Investiments (-) Taxes	Incremental Investiment.	Operating and Maintenance	Totals Economic	Totals Finance	FCash Economic	FCash Finance
0	0	0	0	0	0	0	0	0
1	0	20.461	0	0	20.461	12.752	-20.461	-12.752
2	0	22.507	0	3.760	26.267	18.446	-26.267	-18.446
- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
30	0	0	1.817	5.370	7.187	8.263	7.187	8.263

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

With these results, it was possible to apply the deterministic methods of private analysis, defined as NPV, IRR and B/C.

We used the equation 6, for calculating the NPV of the flow obtained by incremental position presented in Table 14, assuming a discount rate "i" of 7% per year over the "n" useful lives of the estimated project to 30 year old. Therefore, we obtained a negative result of R $ 123.03 million for economic evaluation and a negative result of R$111,963 thousand for financial evaluation. As cash flow has only negative values, since they are not considered benefits of revenue, since the expansion of the primary treatment for secondary does not generate extra revenue for the company, you cannot calculate the IRR expressed by the number of equation 8.

$$TIR: \sum_{t=0}^{n} Xjt\,(1+ij)n-t = 0 \quad (8) \qquad - \qquad \text{Equation 8}$$

For the same way, the value of B / C presents zero when the number of employee expression 9 because there was no incremental benefit arising from the implementation of the project, so this value is null for that expression.

Since not available conversion factors for the market prices, the analysis considered the shadow prices incremental revenue allocated by the WTP by secondary treatment. The latter was obtained by survey directly to users benefit from the system which found the corrected value of R $ 2.84 for the benefits resulting from the implementation of the project, while the costs and investments were those resulting from the same simplified evaluation. These results allowed the construction of cash flows shown in Table 16:

Table 16 - Summary of incremental Situation to shadow prices (in US$ thousand)
Incremental costs Investment, Operation and Maintenance

Years	Total Income	Investiments (-) Taxes	Incremental Investiment.	Operating and Maintenance	Totals Economic	Totals Finance	FCash Economic	FCash Finance
0	0	0	0	0	0	0	0	0
1	0	20.461	0	0	20.461	12.752	-20.461	-12.752
2	0	22.507	0	3.760	26.267	18.446	-26.267	-18.446
3	0	25.235	0	3.760	28.995	20.146	-28.995	-20.146
- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
30	18.003	0	1.817	5.370	7.187	8.263	10.816	9.740

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

From this perspective, based on the calculation of total revenue based on WTP obtained by the CVM, was obtained new results from applying deterministic methods of private analysis, defined as NPV, IRR and B / C, on the same terms used in the evaluation simplified considering the same rates and evaluation periods.

The NPV calculation of the flow obtained by incremental position presented in Table 15 showed a profit of R$ 182,000. It was also possible, the IRR which showed the rate of 7.02% per year to review the shadow prices, since the inclusion of incremental revenue from the WTP became the conventional cash flow, with negative values represented by investments and values positive net benefits represented by the same manner, the value of B / C were equal to 1.0.

Once obtained the profitability indicators, resulting from the application of the private assessment rigid methods, each of these were evaluated according to criteria established for each of the techniques employed.

Net present value (NPV)
In the simplified economic evaluation or short-cut, not considering incremental revenue from the implementation of the project, gave a negative result for this indicator, from R$123.03 million for economic evaluation and a negative result of R$111,963 thousand for financial evaluation.

In the view of Benakouche and Cruz (1994), the VPL presents values below "zero" means that the project is deemed feasible for certain rate "i". In this case, the traditional method of evaluation, the project is not feasible, since its implementation incurs no additional revenue from the investments made.

When doing the assessment the shadow price, which considers the incremental revenue from the WTP for the benefits of secondary treatment, this indicator began to show a profit ofR$182,000 for this assessment. To this author, the NPV has positive values (for a given discount rate), means that future earnings will be higher than the costs and the higher the NPV better the evaluation of the project. Therefore, even if the result has shown substantial increase on the amounts involved, the results obtained by including the WTP demonstrate the feasibility of the project.

Internal Rate of Return (IRR)
To Benakouche and Cruz (1994), this method requires a description of each investment alternative in terms of costs and revenues associated with it. In the simplified economic evaluation or short-cut, was not considered incremental revenue from the implementation of the project, since there is no charge for the additional service, so it was not possible to calculate this indicator.

However, when conducting the evaluation the shadow price, which considers the incremental revenue from the WTP for the benefits of secondary treatment, the quality was a result of 7.02% per annum for economic evaluation the shadow price.

In this sense, Hirschfeld (1998) points out that for a given project can be considered viable by this criterion, it should present the IRR rate equal to or greater than the opportunity cost of resources, in this case, one could consider viable alternative, since both analyzes resulting from the insertion of the WTP, the indicator showed up above the cost of capital opportunity.

It is known that the use of IRR as an indicator has the advantage of dispensing information external to the project, leaving the analyst to know the profile of the project and a minimum of knowledge about the rate of interest or principal of the opportunity cost.

Authors such as Woiller and Mathias (1996) point out advantages of this method when considering the extent of the amount of revenues in time and the fact that a return measure associated with whole horizon of the project, facilitating their comparison to other investment options.

On the other hand, these authors point out the disadvantage in using this indicator the fact assume a constant discount rate over time, which in reality hardly occurs.

These last questions are not necessarily relevant to the project in question, since it was not presented any alternative to what is being assessed, it was merely a matter of choice decision to deploy or not, by its viability.

Benefit-cost ratio (B / C)
As a result of simplified analysis, this indicator showed up with a null value, as there was no incremental benefit arising from the implementation of the project, represented by zero incremental revenue value throughout the life of the project, even if the present value of costs has presented significant value.

In analyzing the shadow price, considering the present value of incremental revenue from the WTP, this indicator takes the value of 1.0, thus it can be concluded for its viability, because, as claimed Benakouche and Cruz (1994) is possible to infer that the project has to be feasible when B / C> 1, indicating that the present value of benefits outweigh the costs discounted present value of the interest rate adopted. A comparative analysis of the results can be summarized in Table 17:

Table 17 – Summary of reviews in R$1,000

	Economic Analysis			Financial Analysis			Economic Analysis		
	Simplified						In shadow prices		
Years	Benefits	Costs	Cash flow	Benefits	Costs	Net cash flow	Benefits	Costs	Net cash flow
2009	0	0	0	0	0	0	0	0	0
2010	0	20461	-20461	0	12752	-12752	0	20.461	-20.461
2011	0	26267	-26267	0	18446	-18446	0	26.267	-26.267
- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
2039	0	7187	-7187	0	8263	-8263	18.003	7.187	10.816
VPL			-123.030	VPL		-111.963	VPL		182
		TIR	#DIV/0!		TIR	#DIV/0!		TIR	7%
Benefi/Cost ratio (B/C)		B/C	0,0		B/C	0,0		B/C	1,0

Source: drawn from the Management Information Bulletin (SANEAGO, 2009).

Finally, it is relevant to mention that in private projects, analysis of indicators always aimed at maximum profitability. Deterministic methods, also called rigid methods, or under certain conditions, consider the information available to the decision maker as relevant, sufficient and reliable to estimate costs and revenues with no margin for error.

In the case of projects that have some gain in social, Benakouche and Cruz (1994) point out that there is a differentiation in the project evaluation by this method, under the private point of view that differs from the evaluation from the social point of view.

For the authors, private assessment considers only the difference between the amount of revenues (benefits) and expenses (costs) generated over time, considered in monetary terms (market value). The analysis from the social point of view needs to other socio-economic parameters to determine the economic value of these surpluses. Note that the models used in the analysis were quantitative, since according to Damodaran (2001), the input data used in these models leave sufficient room for subjective judgments, therefore, the final value obtained shows the impact of the trends that were included in the process.

Since the objective of this study is intended to present a new method of economic evaluation of projects, there was no need to pay great efforts to find input data for the model, given this work to propose to discuss and analyze only the process of evaluation, not the assessment of the product.

6. CONCLUDING REMARKS

The purpose of the study of a method applied to a case example of a company reorganization was part of keeping with the economic and financial evaluation model used by the Sanitation Sector Modernization Program (PMSS).

This model incorporated the contingent valuation method (CVM) to economically evaluate the Willingness to Pay (WTP) for the environmental benefits resulting from investments in sanitation. Thus, the model has met the objectives of this article, which justified its application to the case-example. The socio-economic literature makes it clear that investments in sanitation must meet technical, environmental, economic requirements, seeking sustainable development and preservation of the environment and notably of water resources, with direct effects on the planning of sanitation actions (LEONETI et al, 2011).

With respect to this project, there was divergence between the values obtained in the economic viability indicators of investment projects, analyzed by the method currently employed by the company (market price) and the

proposed method, which integrates economic and social evaluation the environmental benefits arising from the investment.

Indicators calculated based on cash flows related to the method traditionally used by the company showed that the project is not sustainable economically due to the lack of incremental revenue to face the additional investments and expenditures necessary to improve the efficiency of the treatment of household sewage.

This conclusion was given through the use of a hurdle rate, it was decided to assign the value of 7% per year, similar to the cost of funding for this size investment financing and an economic horizon thirty years fixed by the model.

In this scenario, the Net Present Value (NPV) showed a negative result, the Internal Rate of Return (IRR) could not be calculated due to a negative flow throughout economic horizon, while the benefit-cost ratio (B / C) showed a null value, due to the failure to recognize the economic value of the benefit generated.

On the other hand, the incorporation of the economic value of the benefits generated by the project, by calculating the Willingness to Pay (WTP) for secondary treatment, obtained by the contingent valuation method (MVC), proved the economic viability of the enterprise, where the value Net Present (NPV) turned positive, the Internal Rate of Return (IRR) exceeded the hurdle rate and the benefit-cost ratio (B / C) was greater than 1 (one).

The analysis of economic valuation models of the environment and its incorporation to return analytical techniques for investments in sanitation projects dwarf be a viable alternative for choice and ranking of projects that will result in environmental gains, showing economic sustainability.

Thus benefits the company which may provide an improvement to the environment. Such considerations corroborate the research Vanderslice and Briscoe (1995), which show that the water supply and sewage systems provide general benefits for the health of the population through direct and indirect effects, especially in developing level of the population served.

REFERENCES

AGUERO, Pedro Hubertus Vivas. Avaliação econômica dos recursos naturais. Pedro Hubertus Vivas Agüero. 1996, 224 p. Dissertação (mestrado)- Universidade de São Paulo, Faculdade de Economia, Administração e Contabilidade, 1996.

AGUIRRE, Antonio; FARIA, Diomira M.C.P de. A utilização dos preços hedônicos na avaliação social de projetos. Belo Horizonte: CEDEPLAR, 1996.

_____. Avaliação contingente de investimentos ambientais: um estudo de caso. Belo Horizonte: CEDEPLAR, 1995.

AGUIRRE, Antonio; FARIA, Diomira M.C.P de, SUYAMA, Emilio; SANTOS, Gislaine Aparecida. Redução dos custos de quantificação de benefícios na avaliação contingente. Revista Brasileira de Economia. Rio de Janeiro, v.56, n.3, p.377-396, set. 2002.

ALBOUY, Yves (editor). Analisis de costos marginales y deseño de tarifas de electricidad y agua: Estudios de caso. Washingto,D.C.: Banco Interamericano de Desarrollo, 1983.

ALIGLERI, L.; ALIGLERI, L. A.; KRUGLIANSKAS, I.. *Gestão socioambiental: responsabilidade e sustentabilidade do negócio. S*ão Paulo: Atlas, 2009.

AYACH, L.R; GUIMARÃES, S. T. de Lima ; CAPPI, NANCI; Ayach, C. Saúde, saneamento e percepção de riscos ambientais urbanos. ISSN 0103-8427.Caderno de Geografia, v.22, n.37, 2012.

BANCO INTERAMERICANO DE DESENVOLVIMENTO; BANCO DO NORDESTE. Regulamento operacional do PRODETUR/NE II. Disponível em: <http://www.bnb.gov.br/content/aplicacao/PRODETUR/Downloads/gerados/regulamento_operacional_prod_2.asp> Acesso em: 29 set 2009.

BRASIL Lei nº 11.445, de 05 de janeiro de 2007. Legislação Federal. Sítio eletrônico :<http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/lei/l11445.htm>. Acesso em: 16 dez.2009.

BRASIL, Ministério das Cidades. Secretaria Nacional de Saneamento Ambiental. Programa de Modernização do Setor de Saneamento. Diagnóstico dos serviços de água e esgotos – 2007 parte I. Brasília, 2005. 230p. Disponível em: <http://www.snis.gov.br>. Acesso em: 26 mar. 2009.

BRASIL – Fundação Nacional de Saúde. Manual de Saneamento. 3ª ed. Brasília: Fundação Nacional de Saúde, 2007.

BARBIERI, José Carlos. Desenvolvimento e meio ambiente: as estratégias de mudanças da agenda 21. Petrópolis, RJ: Vozes, 1997.

BARBISAN, Ailson Oldair et al. Aplicação do método da avaliação contingente através da técnica de disposição a pagar em área ocupada irregularmente no município de Passo Fundo, RS. Porto Alegre: Revista Teoria e Prática na Engenharia Civil, n.13, 2009.

BELLEN, Hans Michael van. Indicadores de sustentabilidade: uma análise comparativa. Rio de Janeiro: FGV, 2005.

BENAKOUCHE, Rabah; CRUZ, René Santa. Avaliação monetária do meio ambiente. São Paulo: Makron Books, 1994.

BLASCO, Elies Furió. Economía, turismo y medio ambiente. Espanha: Dpt. Economía Aplicada/Universitat de València 1996.

CALDERONI, Sabetai. Os bilhões perdidos no lixo. São Paulo: Humanitas Editora/FFLCH/USP, 1999.

CORREIA NETO, Jocildo Figueiredo. Elaboração e avaliação de projetos de investimento: considerando o risco. Rio de Janeiro: Elsevier, 2009.

CMMAD (Comissão Mundial para Meio Ambiente e Desenvolvimento). Nosso futuro comum. Rio de Janeiro: FGV, 1988.

DAMODARAN, Aswath. Avaliação de investimentos: ferramentas e técnicas para a determinação do valor de qualquer ativo. Rio de Janeiro: Qualitymark, 2001.

FARIA, Diomira Maria C. P.. Avaliação contingente em projetos de abastecimento de água. - Brasília: Ministério do Planejamento e Orçamento. Secretaria de Política Urbana / IPEA, 1995. (Série Modernização do Setor Saneamento, 8).

FERREIRA, Ângela Maria Rodrigues. Análise da disposição a pagar pela preservação do manguezal do Rio Ceará. Revista Econômica do Nordeste. Fortaleza, v.31, n. 4 p. 1034-1049, out-dez. 2000.

GRANJA, Sandra I. B; WARNER, J. A hidropolítica e o federalismo: possibilidades de construção da subsidiariedade na gestão das águas no Brasil? Rio de Janeiro: RAP 40(6): 1097-1121 Nov./Dez. 2006.

GUJARATI, Damodar N. Econometria básica. São Paulo: Pearson Education do Brasil, 2000.

HIRSCHFELD, Henrique. Engenharia econômica e análise de custos. 6. ed. São Paulo: Atlas, 1998.

LEONETI, A. B., PRADO, E. L. do; OLIVEIRA, S. V. W. B. de. Saneamento básico no Brasil: considerações sobre investimentos e sustentabilidade para o seculo XXI. Rio de Janeiro: RAP 45(2):33-48, MAR/ABR. 2011

LONDERO, Elio. (editor). Precios de cuenta: princípios, metodologia y estudios de caso. Banco Interamericano de Desarrollo, Washingto,D.C., 1992.

_____. Beneficios y beneficiarios: Uma introducción a la estimación de efectos distributivos em el análisis costo benefício Banco Interamericano de Desarrollo, Washingto,D.C., 1987.

MACHION, Ane Caroline Grisolio. Valoração ambiental e análise de viabilidade econômica: o caso da estação escola de tratamento de esgotos da Universidade Estadual de Campinas. Campinas, Faculdade de Engenharia Civil, Arquitetura e Urbanismo, Universidade Estadual de Campinas, 2006. 191 p. Dissertação de Mestrado.

MAIA, José Afonso Ferreira; SILVA, Sandra Almeida da; SILVA, Cristiane Almeida da. Metodologia para avaliação econômica e social de políticas públicas. Feira de Santanta/BA: Sitientibus, 2005.

MATTOS, K. M. da C.; FERRETTI FILHO, N.J.; MATTOS, A. Uma abordagem conceitual sobre a valoração econômica de recursos naturais. In: Simpósio sobre Recursos Naturais e Sócio-econômicos do Pantanal, 3., 2000 Corumbá-MS. Disponível em: <http://www.cpap.embrapa.br/agencia/congresso/Socio/MATTOS-043.pdf> Acesso em: 22 out. 2009.

MATOS, Maria Cristina Pereira. Alianças intersetoriais: um estudo no município de Cubatão/SP. Tese de Doutorado – Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo, 2007. Disponível em: < http://www.teses.usp.br/teses/disponiveis/12/12139/tde-04052007-122825/> Acesso em: 22 nov. 2009.

MAY, P.; LUSTOSA, C.; VINHA, V. (organizadores). Economia do meio ambiente: teoria e prática. 2ª reimpressão. Rio de Janeiro: Elsevier, 2003.

MENDONÇA, Alzino Furtado de; ROCHA, Cláudia Regina Ribeiro; NUNES, Heliane Prudente. Trabalhos acadêmicos: planejamento, execução e avaliação. Goiânia: Faculdades Alves Faria, 2008.

MOITA, C. M.; FARIA, D. M. C. P.; MIRANDA, E. C. de.; TAGLIARI, M. Metodologia de avaliação econômica e financeira de projetos: a experiência do PMSS II. Brasília: IPEA, 1998. 242 p. (Série Modernização do Setor Saneamento, 13).

MOTTA, Ronaldo Seroa da. Economia ambiental. Rio de Janeiro: FGV, 2006.

NOVAES, Washington (Coord.). Agenda 21 brasileira – Bases para discussão. Brasília: MMA/PNUD, 2000.

NUNES JUNIOR, Mário S. Valoração ambiental: Casos da Mineradora Viterbo Machado Luz. 2003. 79 p. Dissertação (Mestrado em Administração e Política de Recursos Minerais), Universidade Estadual de Campinas, Campinas, 2003.

ORGANIZAÇÃO DAS NAÇÕES UNIDAS (ONU). Programa de Desenvolvimento Sustentável/Padrões de produção e consumo. Disponível em: <http://www.un.org/esa/sustdev/conprod.htm>. Acesso em: 15 set 2009.

PEREIRA, Otávio; NASCIMENTO, Luis Felipe. Projetos de tecnologia de infra-estrutura urbana – das fases de análise econômica e licenciamento à gestão ambiental. Artigo-Associação Brasileira de Engenharia de Produção, Rio de Janeiro, 1997.

Disponível_em:<http://www.abepro.org.br/biblioteca/ENEGEP1997_T6408.PDF>. Acesso em 10 set. 2009.

POWERS, Terry A. (editor). El calculo de los precios de cuenta em la evaluacion de proyectos: estudios de casos com base em el método Little-Mirrlees/Squire-van der Tak. Washington,D.C.: Banco Interamericano de Desarrollo , 1981.

PESSOA, RUBEN; Ramos, F.S. Avaliação de Ativos Ambientais: Aplicação do Método de Avaliação Contingente. RBE Rio de Janeiro 52(3):405-426 Jul./Swt,. 1998.

ROESCH, Sylvia Maria Azevedo. Projetos de estágios e de pesquisa em administração: guia para estágios, trabalhos de conclusão, dissertações e estudos de caso. 3. ed. São Paulo: Atlas, 2005.

SANEAGO–Saneamento de Goiás S/A. *Boletim de informações gerenciais*. Goiânia, 2009. Disponível em: <http://intranet.saneago.com.br/arquivos/boletim3/ arquivos/set09/beneficiadaagua.pdf>. Acesso em: 11 fev. 2010.

_____. *Programa de água potável e esgotos sanitários das cidades de Goiânia e Goiás: avaliação econômica*. Ampla Visão Assessoria e *Serviços (1997).*

SEPIN – Superintendência de Estatística, Pesquisa e Informação. Estatísticas Municipais (Séries Históricas).

Goiânia, 2010. Disponível em:< http://www.seplan.go.gov.br/sepin/>. Acesso em: 19 mar. 2010.

TOLMASQUIM, Maurício Tiommo. Economia do meio ambiente: forças e fraquezas. In: CAVALCANTI, Clóvis (Org.). Desenvolvimento e natureza: estudos para uma sociedade sustentável. São Paulo: Cortez, 1995.

TONETO JUNIOR, R. A. *A situação atual do saneamento básico no Brasil: problemas e perspectivas.* 2004. 324 f. Tese (livre-docência em economia) – Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo, 2004.

VANDERSLICE, J.; BRISCOE, J. *Environmental interventions in developing countries: interactions and their implications.* American Journal of Epídemiology, v. 141, p. 135-144. 1995.

WOILER, Samsão; MATHIAS, Washington Franco. Projetos: planejamento, elaboração e análise. São Paulo: A Atlas, 1996.