



Addressing social aspects associated with wastewater treatment facilities



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ABSTRACT

In wastewater treatment facilities (WWTF), technical and financial aspects have been considered a priority, while other issues, such as social aspects, have not been evaluated seriously and there is not an accepted methodology for assessing it. In this work, a methodology focused on social concerns related to WWTF is presented. The methodology proposes the use of 25 indicators as a framework for measuring social performance to evaluate the progress in moving towards sustainability. The methodology was applied to test its applicability and effectiveness in two WWTF in Mexico (urban and rural). This evaluation helped define the key elements, stakeholders and barriers in the facilities. In this context, the urban facility showed a better overall performance, a result that may be explained mainly by the better socioeconomic context of the urban municipality. Finally, the evaluation of social aspects using the semi-qualitative approach proposed in this work allows for a comparison between different facilities and for the identification of strengths and weakness, and it provides an alternative tool for achieving and improving wastewater management.

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1. Introduction

The world is facing a global water quality crisis. The continuing population growth and urbanization, climate change and expanding and intensifying food production are all putting pressure on water resources. In fact, water may become the most limited resource in large cities of developing countries (Godfray et al., 2010; Mulder et al., 2010). In addition, an inadequate water infrastructure and limited management systems increase the stress on the resource and may lead to a predictable water crisis in many locations (Pandey et al., 2010, 2012). Awareness raising and developing a feeling of ownership of society or people to protect the scarce water resource are primarily important because they are the one who actually consume the resource (Manandhar et al., 2012). However, many water-related studies often miss the component of social engagement and analysis (Manandhar et al., 2013).

In Mexico, approximately 93% of all inhabitants have access to improved drinking water sources, and 91% have access to improved sanitation; further, 50% of all collected sewage enters a wastewater treatment facility (CONAGUA 2014). However, these statistics do not reflect the management performance, the quality of water or the participation of social actors and other stakeholders in the access to water and sanitation services.

Based on the foregoing context, it is imperative for urban environments in developing countries to implement sustainable solutions to fill the gap in the existing infrastructure for wastewater treatment facilities (WWTF) regarding both quality and quantity issues. This challenge

may be accomplished by implementing new administrative systems that consider the limitations and conditions of the region and by adopting innovative and adaptive options to the existing conventional solutions based on social participation (Noyola et al., 2009).

An important element in an urban water system is the WWTF, though it is often neglected in developing countries, because it is responsible for pollution removal and, consequently, for environmental and public health protection. A sustainable system for waste management must be environmentally effective, economically affordable and socially acceptable (McDougall et al., 2007). In addition, it must be safe for workers and for the surrounding community, with particular attention to possible affected stakeholders.

Successful applications of sustainable wastewater systems require several management issues to be addressed. In this regard, the WHO, 2000 has identified several key concerns: user opinion and satisfaction, community/household management issues, the level of service, financial performance, materials, personnel, equipment and work control indicators. Others tools such as Social Impact Assessment, SAI 8000 and IFC have played an increasingly important role in the conduct of planned interventions (Center for Good Governance, 2006; Richards and Panfil, 2010; IAIA, 2003; Arce-Gomez et al., 2015) providing the capacity to assess the social consequences of human activities. However, these frameworks fail to evaluate and integrate an approach that involve, simultaneously, all actors that play an important role in the wastewater management, in specific social aspects. The proposal is objective since it uses BR based on Distance to Target methods to value indicators. It entails obtaining qualitative and quantitative measurements from distance that separate the actual interventions from the targets, assigning a quantitative number (non-dimensional number) that

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help to normalize stakeholders and aggregate them in order to generate a single social index. In order to calculate the total social impact for technical side of the sanitation the use of a social index facilitates the interpretation of results by avoiding subjectivity involved in the process due to the ideological elements.

Although the technical and financial aspects of wastewater management (WWM) have often been considered a priority (Wilderer and Schreff, 2000; Gray and Booker, 2003; Sarikaya et al., 2003), other concerns, such as social and institutional aspects, have not been assessed or considered seriously enough and have often been disregarded. To overcome this situation, a system for assessing the impact of WWTF on social wellbeing should be available, though the question remains: how should this assessment be conducted? In fact, unlike the environmental impacts, many social impact indicators are not easily quantifiable. One way to develop social aspects criteria is by analyzing the identified stakeholders at a local level (Manik and Halog, 2013) and then employing a scoring system to facilitate data interpretation and assessment, thereby relating the information to performance reference points (Benoit et al., 2010). This approach is based on the consideration that social factors are crucial in determining effective solutions to improve the performance of the WWTF and to move towards sustainability.

The main purpose of this study is to present a methodology for evaluating the social aspects applied to WWTF. The methodology is based on sustainability indicators as a framework for measuring wastewater management and its progress towards sustainability. This approach can disclose the hotspots in social issues related to sustainability, which in turn can lead to strategies and policies to support the development of sustainable WWTF. The methodology evaluates 25 indicators that were developed using different sources of data: questionnaires, household interviews and observations, based on a previous identification of the relevant stakeholders involved in WWTF. Moreover, the paper discusses the results obtained from testing the proposed approach on a comparison of two actual WWTF in Mexico at both urban and rural locations.

2. Approach

Some studies related to environmental evaluation in WWTF and social evaluation in engineering have been developed; however, few works have been related to the social analysis of water or wastewater. Table 2 presents the most relevant published studies related to social evaluation in general and those related with WWTF, with a short description of their framework and the indicators and stakeholders involved. In this list, the present study is included for comparison.

The methodology proposed was developed for the sanitation sector and addresses the identification, qualification and evaluation of social and wastewater management issues related to WWTF. Table 2 summarizes the indicators that have been identified as relevant for assessing the effective use of available resources and, thus, the opportunities for improving WWTF efficiency. A social assessment that is based on the means of indicators provides a big picture to facilitate interpretation by summarizing the multidimensional issues and thus supporting decision-makers. In this sense, Singh et al. (2009) and Saisana and Tarantola (2002) stated that social indicators are increasingly recognized useful tools for policymaking and public communication conveying information on the water situation.

The literature shows that in most applications related to wastewater resources, the evaluations have been made using a technical or economic perspective (Muga and Mihelcic, 2008; Sujaritpong and Nitivattananon, 2009; Del Saz-Salazar et al., 2009; Molinos-Senante et al., 2010; Bieker et al., 2010; von Sperling and Chernicharo, 2002). However, the classification of indicators related to specific stakeholders and their evaluation using performance reference points based on international targets have not been developed to date and constitute the base of this methodology (Table 2).

Some others frameworks such as Social Impact Assessment (SIA) considers all the issues linked to a project (that can be applied to

WWTF) that affects or concerns any impacted stakeholder group associated with a planned intervention. However, according to IAIA (2003) and Burdge and Vanclay (1996) there are many issues to consider when applying SIA in a truly international context. The regulatory context varies, the cultural/religious context varies, and social and economic priorities for development vary. SIAs are often done by consultants who do not know relevant social and economic theory, and who may not be trained in either SIA or social science methodology. SIA is seen as a single event, as a discrete statement of impacts, not as a process which develops its full potential in the mitigation of impacts, and as a process which governs the planning and development process.

To avoid issues described above we propose the classification of indicators according to the stakeholders involved to facilitate the impact assessment and interpretation, both, on a single basis and on groups of related indicators. Additionally, the use of stakeholders provides a comprehensive basis for the interconnection of the social issues evaluated. This approach agrees with UNEP/SETAC (2009), which noted that such indicators should be the result of a multi-stakeholder discussion process.

Thus, in this work, the use of performance reference points and BR for criteria evaluation is proposed (detailed in Section 3.2). By these means, it is possible to transform qualitative information into quantitative data (1 to 4; with 1 being the worst and 4 the best assessment), thus giving the method a semi-qualitative character. Hence, and in accordance with Ramirez et al. (2012), the method can be objective when analyzing social behavior or subjective aspects, which is an important matter when a social evaluation is conducted.

3. Development of methodology framework

The steps of the proposed framework are 3.1) defining goal and scope, 3.2) developing evaluation criteria, 3.3) gathering data, 3.4) scoring selected indicators, and 3.5) interpretation and applicability. Each of these steps and the case study under consideration are explained as follows:

3.1. Defining goal and scope

This section serves as a guide for elaborating the goal and scope. The goal must state the intended application, the purpose and the reasons for carrying out the study. The scope should be sufficiently well defined to ensure that the breadth, depth and detail of the study are compatible to address the stated goal. The scope includes the description of the system to be studied and its boundaries.

3.2. Developing evaluation criteria

The purpose of identifying and selecting criteria is to provide a mechanism to determine and translate the goal identified in step 1 into a set of guiding principles that serve to select stakeholders involved and the indicators that will be analyzed. This step also comprises the process for establishing the scoring tools to assign quantitative values to the selected indicators.

3.2.1. Selecting stakeholders and performance indicators

The stakeholders and performance indicators were identified according to the factors that affect WWTF performance (Fig. 1). Social and wastewater management were chosen among the four key factors (the other two are technical and economic aspects) to assess wastewater treatment operations, according to WHO (2000); Balkema et al. (2002); Al-Sa'ed and Mubarak (2006); Wilderer and Schreff (2000); Gray and Booker (2003) and Sarikaya et al. (2003). Regarding the social factors, the Social Life Cycle Assessment (SLCA) (UNEP/SETAC, 2009) approach was considered to establish the stakeholders' categories. Twenty-five indicators were selected, according to their relevance and importance in the WWTF, and they were categorized and classified according to the stakeholders involved. The names are given according to the role they play in the wastewater management system according

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