

# Should we invest in small systems of Reclamation and Reuse Wastewater? Some tools for wastewater projects analysis.

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## 1. Introduction.

The main objective of this paper is to provide a methodology for the technical-economical analysis of Reclamation and Reuse Wastewater Systems (RRWWS). This proposal takes into account the evaluation of private and external impacts of the system, and could be considered to be a tool in order to make easier, for decision-makers, the solution of problems related to implanting and operating RRWWS, even under uncertainty scenarios. This methodology evaluates WWRRS, from a multidisciplinary and interdisciplinary perspective, and always assuming that the main objective of a Reclamation and Reuse Wastewater Project is to determine the maximization of the benefits, (both private and external).

A fundamental part of this proposal is related to external effects generated by RRWWS. The practice of wastewater reclamation and reuse entails a set of private and external impacts, with no price, but which are certainly valued both by consumers and producers. For instance, negative external impact such as third-parties injuries which can be attributed to the reuse of reclamation waters, or positive external effects like the reduction in the pollution of water masses, the recovery of material and energy, and/or the increase of water availability. These impacts altogether could induce wastewater reclamation and reuse to become a profitable activity, from a private economic perspective.

This paper presents basically a tool in order to make technical-economical analysis of RRWWS easier for decision-makers, (usually under the scope of the hydraulic sector), in order to construct a supported judgment, both technological and economical, to invest or not in these systems. The proposed methodology considers the identification, quantification and economic valuation of several impacts, (both private and external), and the selection of the alternatives in order to optimize total benefits. This methodology evaluates RRWWS, from a multidisciplinary and interdisciplinary perspective (and always accepting that the first interest of professionals and managers is related to maximize private profits of the project).

## 2.Methods.

The methodology can be applied assuming seven main steps that should be fulfilled for its application. These steps are: 1) Definition of objectives, 2) Definition of the scope of the study, 3) Project impacts, 4) Identification of involved agents, 5) Study of financial needs and possibilities, 6) Aggregation of costs and revenues, and 7) Sensitivity analysis.

The aggregation of costs and revenues is an essential point of this methodology, which is given mainly by the aggregation of private profits and externalities. This allows to visualize two main separate circumstances: 1) The RRWWS feasibility, which could be defined by private benefit determination (situation normally interesting for technicians and politicians); and 2) The RRWWS being economically, financially and environmentally feasible, which provides both private and social benefits.

In the recent literature on RRWWS, no methodological procedure can be found that could allow to link technical and economical aspects. Usually methodologies assume that the economic variables determine, in a significant way, the design and creation of the model, but the model does not affect these variables. RRWWS only point out about the need of some economical analysis, and usually concentrate their priorities in RRWWS private costs. Nevertheless, similar methodologies have been applied, for instance, in small systems of water treatments at Costa Brava (in Girona, Spain). Furthermore, some applications can be found in the literature, such as Deniz, F et al (2010), Molinos-Senante et al (2010), Hernández et al (2006), Hernandez Sancho et al (2008), and Urkiaga et al (2006).

Regenerated water costs and prices are important in the design and operation of a RRWWS. Although some detailed information about the costs of a RRWWS can be usually obtained, without serious difficulties, it is not the same for the reclamation water. This is mainly because there is not a reclamation water market which could determine water prices and, therefore, the only reference is the price of water from conventional sources. Nevertheless, this price does not reflect all the impacts that entail the reclamation and reuse of wastewater.

No matter that, the impacts, (either positive or negative), that the implantation of a RRWWS could induce are mentioned and described in the literature. It is not easy to find works that collect and assembly, from a methodological approach, the identification and description of the most important impacts to be considered when a RRWWS is implanted.

That is, within the scope of the reclamation and reuse of wastewater, there are not so many methodological proposals that could link biophysical impacts from RRWWS, and their economic effects. In the paper, two real cases are discussed, both in the North East of Spain: Colera and Empuriabrava.

## 2. Results and Discussion .

The RRWWS of Colera, with the main objective to increase the water supply for private uses and the RRWWS of Empuriabrava that provides regenerated water for public uses. Main results indicate that the Colera RRWWS could provide a maximum profit of 6.3089 €/m<sup>3</sup>, whereas in the RRWWS of Empuriabrava, profits could be up to 0.5919 €/m<sup>3</sup>. In order to recover all the costs related to the RRWWS, the minimum price at which regenerated water should be provided, (in order to ensure its technical-economic feasibility), is of 1.6919 €/m<sup>3</sup> for the RRWWS of Colera, and 0,3596 €/m<sup>3</sup> for the RRWWS of Empuriabrava.

## 3. Conclusions.

Therefore, a fundamental aspect to point out in this paper is that a narrow association between technical and economical areas exists, and that a relevant purpose is to visualize the analysis from an interdisciplinary perspective. Under this perspective we look for the solution of this problem that can be usually found nowadays for the planning of RRWWS. The main results of this paper indicate that the methodology which is introduced is suited to the peculiarities of RRWWS in such a way that it turns into a "custom made" tool, that allows decision makers to state an assessment on the convenience or not to implement this kind of Systems.

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