

## AN ECONOMIC APPROACH TO RECLAIMED WATER USE: THE DIFFICULTIES OF THE SMALL FARMERS

**Amelia Díaz<sup>1</sup>, Miquel Salgot<sup>2</sup> and Manuel Soler<sup>3</sup>**

<sup>1</sup> *Grup d'Hidrologia Subterrània. Universitat de Barcelona, Spain and*

<sup>2</sup> *Reial Acadèmia de Farmàcia de Catalunya, Barcelona, Spain*

<sup>3</sup> *Universitat Politècnica de Catalunya, Barcelona, Spain*

### **ABSTRACT**

Wastewater reclamation and reuse is governed by a number of conditions, established by the rules and regulations enforced by the European Union (EU) and supported / modified by the EU countries National Regulations.

The risk evaluation measures mandated by these EU Regulations, indicate that it is compulsory to check the economic viability of any reuse project.

The process of wastewater reclamation and reuse starts with the decision to implement a project and reaches the conclusion when reclaimed water is used for irrigation.

Then, two types of costs can be defined: the ones related to the infrastructure / operation and the non-physical ones. At first sight, the cost of any of the steps of the project must be attributed to the different actors. In the case of the end user, the rules establish that the reclamation process starts after the secondary treatment; i.e., the point of delivery from the WWTP to the Reclamation facility. Before this point, all the costs must be attributed to the previous actors and officially to the water administration, which collects taxes to cover the costs (Díaz and Salgot, 2022).

The reclamation process requires several steps, from the decision of changing the source of supply to the reclaimed water delivery, and a certain number of intermediate steps (Table 1).

**Table 1.** Reclamation treatment lines and attributed costs

| <b>Reuse line point</b>                          | <b>Implies</b>   | <b>Comments</b>  | <b>Costs attributed to:</b>                                     |
|--|--|--|---|
| Proposition of the reclamation and reuse project | Promoter/developer/water authorities' activities                               | Initial acceptance of the prospective user                     | Administration<br>End users if they are asked for               |
| Initial studies                                  | Define the zero-point conditions (before the project)                          | Environmental, social and economic basis<br>Wastewater quality | The promoter of the initiative (can be an association of users) |
| Decision   | Political acceptance   | Can modify the calculation basis                               | Administration  |
| Risk evaluation (previous)                       | Calculation on all aspects related to risk                                     | Compulsory   | Uncertain   |
| Project preparation                              | Pre-engineering works<br>Prospective budget                                    | Specialised companies  | Uncertain (administration?)                                     |
| Final project                                    | Construction project   | Revisions and modifications                                    | The promoter  |
| Evaluation by the administration                 | Health and water-related administrations                                       | Possibility of veto  | Administrations   |
| Risk evaluation                                  | Evaluation of the expected water quality results                               | After starting regular operation                               | Uncertain / end-user  |
| Modification of infrastructures and controls     | Civil works  | Rain management.<br>Expected mixtures with other water sources | Uncertain   |
| Controls of sewerage system and discharges       | Identification of the industries and activities, and its wastewater management | Changes needed quite in all projects                           | Wastewater management administration                            |

|   |  |  |  |
|---|--|--|--|
| Treatment up to the legal point             | Alternative disposal: Water bodies or reclamation facility | If all produced water is not fully used                |  |
| Treatment up to the quality level necessary | Additional costs   | Usually, advanced treatments and disinfection          | End user or subsidies                        |
| Point of delivery to the end-user           | Change of responsibility                                   |  | No cost                                      |
| Use   | Adaptation of the existing application systems             | Irrigation methods' changes                            | End user or subsidies                        |
| Description of barriers                     | Relationships with the improvement of the quality          | Calculations specified in the rules must be considered | End user or associations: Mainly bureaucracy |
| Emergency procedures                        | Knowledgeable by all users                                 | Must be easily available                               |  |
| Final use of reclaimed water                | All necessary controls                                     | Includes products and environmental distribution       | End user or / and subsidies                  |

Shaded in which involves small end-user  
End-user(s) or associations of users (e.g. cooperatives) as indicated by the law

A step which has not been considered at all is the information, formation and communication on wastewater reclamation and use. It requires appropriate and end-user adapted methods.

The economy of the projects is related to the infrastructures (investment and operation) necessary to treat wastewater up to the demanded quality. However, there are costs not directly related to infrastructure, such as the inherent bureaucracy, the evaluation of mandatory analytical procedures and negative external effects that may affect groups not directly involved in the process.

Any project is developed in relation with a defined environment, i.e., a nexus soil-water-plants in a specific area. Developing this aspect, it is to note that it is compulsory to adjust the relationship of the cultivated crop to the quality of the brand-new irrigation water, to keep the product marketable.

Then, it is necessary to establish the initial characteristics of the sites, in terms of soil types and its variations, water characteristics in relation with the soils and existing vegetation and wildlife. The impacts, direct and indirect, on the whole environment must also be an important aspect of the practice. Specialists are needed for those evaluations, including social and environmental costs. This also means expenses.

Once the reclamation and reuse project is accepted, a new aspect of economy starts, including direct engineering costs, distribution and application: the structures related to water reclamation, transport to the use sites; and several storage facilities if deemed necessary, final distribution, application and control of the whole system (the nexus).

A discussion appears defining the expenses to be attributed to the end-user or to the administration. A similar approach could indicate to whom reuse barriers' cost should be attributed and who must bear the related control expenses.

A logical and legal approach indicates that the expenses related to the quality demanded for treated wastewater disposal should be paid by the administration, while from this point on (advanced treatment, additional disinfection) the user must cover the expenses. Sometimes, the farmer is forced to exchange the existing supply for reclaimed water, and in this case must be acceptable to subsidize the end user (Generalitat de Catalunya, 2023).

The project is inserted in a real world, with relationships with the people related to the practice in terms of agriculture, commercialization and consumption. There is also a social aspect, including the acceptance of the resource and the crops produced.

The EU establishes that reclaimed water should be delivered to an association not to a single user, which can modify the distribution of expenses. It can establish a new threshold; the delivery point from the distributor to the real end-user. Here, it is necessary to define clearly the circumstances of such a change.

Usually, the associations of users / cooperatives and the like gather a number of partners. Mainly, the irrigation polygons are formed by a number of small users and perhaps a few large landowners. Nevertheless, any combination is possible. Then, the costs are attributed according to the surface owned or to the amount of water used.

One of the main ideas of delivering water to an association is related to the economy of scale; i.e. the general expenses (analysis, evaluation) are assumed by the association, instead of being attributed to any single user. It means a reduction of costs, important especially for the small farmers using reclaimed water or the mixtures with other sources.

From what it is listed in Table 1, it seems evident that part of the costs must be supported by the end-user; but it is not so clear how small users must pay, and if they are capable to support those expenses (Winpenny et al. 2010).

At this point, the water authorities should decide if reclaimed water is subsidized or not. Then arises the doubt about

the “legality” of such a measure that seems to contradict the rule that indicates that all costs should be paid by the user.

Then, the discussion reaches the origin of the practice. It is to remember that many times, reclaimed water substitutes good quality water that moves to other uses; and this must be compulsory. Then, there is a reason to subsidize the practice and do not charge the end-user the additional costs incurred. This is the case, for example in the Autonomous Community of Murcia, in Spain. The regional government supplies reclaimed water free of charge to the farmers.

A different approach is what happens after the supply of reclaimed water. The end-user must guarantee by law, that the quality of irrigation water is maintained until the point of use. It happens then, that end-users need to have a water with characteristics good enough to guarantee the success of the crop in the market, as indicated before. Given the usual quality of reclaimed water (e.g. higher salinity than first-hand irrigation water) the mixture with other water resources is common practice.

Another point of discussion is the need to compulsorily record for what purpose (i.e. type of crop) and which amount of reclaimed water is used in any case. It adds to the burden of bureaucracy associated to reclaimed water use.

It is not to forget the controls (a cost) that the end-product must suffer before entering the commercialisation procedure or during it.

Quite in all cases, it is difficult for a single small farmer to evaluate the big amount of analytical data received. For this reason, it is suggested that the association hire an expert for those evaluations (again an added cost).

**Table 2.** Conditions for the success of reuse practices at the small farmer level

|   |  |  |
|---|--|--|
| <b>Knowledge</b>                                  | Guarantee that all the relevant characteristics of the practice are evident for the small user               | Establish adequate information and formation sources     |
| <b>Economy</b>                                    | Study up to which point the practice is affordable   | Reliable information                                     |
| <b>Health-related</b>                             | Mentalize the farmer of the health-related risks of the practice   | Specific education                                       |
| <b>Relationships with distributors of produce</b> | Carefully and previously define if the irrigated crops will be accepted throughout the distribution channels | Previous agreements are deemed necessary                 |
| <b>Reliability</b>                                | The end-user should trust the agricultural authorities and other actors                                      | Do not cheat on reuse; the trust is difficult to recover |

In terms of affordability of the practice and under the point of view of the small user, the attribution of costs is as indicated in the Table 3.

**Table 3.** Distribution of costs for a small farmer

| <b>Item</b>            | <b>Description</b>  | <b>Comments</b>  |
|------------------------|---|--|
| Infrastructure         | From the delivery point on, including storage (if existing) and distribution<br>Irrigation systems<br>Control | Part of the infrastructure can be recovered / recycled from the previous irrigation system |
| Quality control        | To be performed for:<br>- Reclaimed water<br>- Produce<br>- Environment                                       | At the indicated / compulsory points   |
| Bureaucracy            | Staff<br>Farmers' employees (additional)  | It is mandatory to declare the use of reclaimed water                                      |
| Evaluation             | Specialists on risk evaluation  |  |
| Other associated-costs | Energy<br>Supplies and specific services<br>Support to the farmer's associations<br>Manpower                  | Several systems need specific additional research  |

Not all the indicated in Table 3 must be defined in the calculations of each reuse facility, but the costs are specific for every site and must be calculated accordingly. Part of the items should be prorated among the partners (e.g. small farmers) of the project.

Other expenses should be directly attributed to the authorities, like the final evaluation and permissions to operate,

which is usually detailed in official publications which define the plans at different dates (short, medium and long-term) in the future: Those publications usually include an estimation of costs (Generalitat de Catalunya, 2023).

In monetary terms, the discussion arouses on the comparison of costs among:

- Tap water supply (not allowed for irrigation)
- The other sources of irrigation water
- The application expenses (energy, machinery, ...)

In this case, it is not easy to perform the usual calculations for the economic evaluation of wastewater reuse (Hernández-Sancho et al., 2021) in terms of regional approaches.

## Conclusions

The success of wastewater reclamation and its use depends on the economy of the process, which in turn creates difficulties to the small farmer which uses such resource: It is not clear if this operator is capable to understand the full economy of the practice as well as support all the expenses included.

It is necessary to inform the small farmer before the beginning of any action in a clear, understandable way, on what he is embarking on when reusing and the constraints he will face.

At a given moment, the small farmer can be forced to abandon his activity, associate into cooperatives and similar to cover the expenses incurred when reusing, or selling the property of the land and become an employee of greater enterprises. It seems necessary to develop alternatives to maintain its present state of the question.

In some cases, the wholesalers or the supermarket chains do not accept crops irrigated with reclaimed water, creating a new burden to the small farmer.

The change of the usual water supply to reclaimed water can be compulsory, which in some way limits the freedom of the farmer to cultivate what he wants, according to the market needs.

The role of water, health and other authorities and its relationships with the end-user should be clearly defined.

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