EXPERIMENTING WITH TREATED WASTEWATER: SITUATED KNOWLEDGE AND DEMONSTRATION

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1. The role of demonstration sites and the credibility of innovative solutions

In the water sector, the use of pilot schemes to generate knowledge is commonplace. These can be used to demonstrate the efficiency of a new irrigation technique, test new treatment processes or assess the added value of in-depth modelling to achieve water savings. Current research funding arrangements encourage the setting up of experimental platforms designed to pool instrumentation tools and bring together a diversity of partners from both academia and industry (Stengers 2013). Far from being neutral devices, the literature shows that experimental sites are likely to play a role on the object studied, by supporting the development of a technique for example, or by serving as a support to promote given ideas (Bonneuil 2000, Cardona et al. 2018). Furthermore, the media coverage - through visits to more or less specialized public events, press articles, conferences - of some of these experimental sites suggests that their role goes beyond that of providing proof (Rosental 2009). This raises the question of the role of experimental research facilities as promotional tools and/or knowledge producers. This question may be raised with regard to experimental schemes for the Reuse of Treated Wastewater (REUSE). In France, the regulatory framework for REUSE initially encouraged pilot projects to emerge, in order to increase knowledge. It is therefore postulated that experimental schemes shape the way in which treated wastewater (TWW) exists in society, by making the REUSE solution credible and feasible. In line with the work focusing on research activities within this type of system or its suggested new organizational forms (Woolgar and Latour 1988, Hubert 2015), we intend to make this 'situated' knowledge (Haraway 1985) intelligible and then study its circulation in public space and debate.

This involved a multidisciplinary team (sociology, agronomy, economics, ecology) critically reading the knowledge produced on the experimental sites. This multidisciplinary composition made it possible to mobilize a diversity of skills with a view to identifying the questions posed by stakeholders involved in the demonstration sites and interpreting limits (conditions for producing proof, skills, methodology, etc.) and shortcomings (environmental dimensions, for example). From a methodological point of view, a common reading grid was applied to all the reports produced, and above all available, at the selected demonstration sites. Three demonstration sites were identified, all located in the Occitanie region (South of France). These sites were chosen because they serve as showcases for the REUSE demonstration in the region: i) at the Irrialt'eau site, experiments began in 2013, supported by a partnership between research (INRAE) and the private sector (Veolia). REUSE has been operational since 2021 to irrigate a potential 80 hectares of vineyards; ii) the Rur'eaux site started up in 2019, under the coordination of a a firm of consultants specializing in REUSE (Ecofilae), involving researchers and start-ups in the field of water purification; iii) the Roquefort-des-Corbières site has been operational since 2019 to irrigate 15 to 20 hectares of vineyards and is carried out by a private actor (BRL) and public research (INRAE).

2. Knowledge: Risk Assessment, Purification Performance and Potential Uses

The knowledge generated by experimental sites covers three main areas. The first concerns the purification capacity of the treatment processes. Its aim is operational in the sense that, when the pilot sites were being set up, the REUSE regulations in France were being drafted based on a classification system providing water categories equivalent to authorized uses. On the two sites studied, the processes tested were chosen according to the intended agricultural uses, vineyards (Irrialt'eau) and market gardening (Rur'eaux).

The second area of knowledge production concerns risk assessment. The key question is the contamination generated by REUSE. To answer this question, two approaches coexist. The first is to assess the risk according to the indicators and thresholds defined by regulations. At both sites, all the regulatory indicators were systematically monitored. The second approach consists of assessing risks not covered by the regulatory framework. At the Irrialt'eau site, for example, the scientists chose to carry out analytical campaigns on around fifty parameters, as opposed to the six listed in the regulations. Some of the molecules relate to legislation on water discharges of hazardous substances, while the others belong more broadly to the family of emerging micropollutants, rarely monitored in water. At the Rur'eaux site, the choice was made to monitor five medicinal molecules not included in the regulations.

In addition, French regulations require a control point at the end of tertiary treatment as a minimum requirement. Research on experimental sites goes further. The aim is to assess the sanitary quality of TWW at several circulation points (point of use, storage) and contamination risk in other compartments of the agronomic system (plants, soil, fruit). This monitoring addresses a variety of issues: do TWW become contaminated during transport? What contamination of plants, soil and groundwater does the TWW cause? What are the effects of salt accumulation in soils?

The third area of knowledge production concerns the potential use of TWW in agriculture as inputs. This is assessed by studying the effects of nutrients on plant growth and productivity (yield), while also weighing up the risks of salinization through soil accumulation.

3. Situated Knowledge and Production Conditions

Several factors help in explaining the organization of knowledge production along these three dimensions. One of these factors is linked to the context in which the experimental sites emerged, because the French regulatory framework at the time was recent and untested by empirical reality. The purpose of the sites was to demonstrate whether the regulatory choices were operational. To this end, tests were carried out on the treatment processes to bring the TWWs into compliance with the risks defined by regulations.

Another factor has to do with the experimental framework, which allows testing that is not yet regulated, in accordance with prefectural authorizations. It falls to stakeholders to define appropriate research questions according to their disciplinary background, financial capacities and research objectives. At the Irrialt'eau site, for example, analysis of the risk associated with emerging micropollutants is of particular interest to scientists in environmental microbiology, biochemistry and microbial ecology in waste treatment and recovery. Studying contaminants in TWWs comes directly under their research activities. They also had the internal skills to carry out the often costly analyses themselves. The situation was different on the Rur'eaux site, where the scientists involved were based in agronomy and process engineering. Monitoring contaminants was not a priority in the tests carried out, which may explain why only five molecules were monitored. Budget constraints may also explain this.

The choices made are also influenced by the consortia set up between public research and industry. The latter have a particular interest in demonstrating the robustness of their technical know-how to market it later. With this in mind, they have in some respects hindered public research, under cover of confidentiality clauses, as was the case at the Irrialt'eau site where the monitoring of several contaminants was halted, and the publication of results prevented.

Operational aims of on-site research are another factor influencing the choice of knowledge to be produced. On the Irrialt'eau site, a key operational aim was to make a water resource available for watering vineyards in an area without a collective irrigation network and suffering from increasingly severe drought. On the Rur'eaux site, the ambition was to determine a treatment method at an acceptable cost for small rural communities, leading to an economic evaluation of several treatment methods (<2000 p.e.). The effects of TWWs storage on their quality are also being tested with an operational perspective, since storing TWWs allows bypassing summer withdrawal restrictions and securing access to water.

Finally, the arguments in favor of deploying REUSE are also a source of concern. One of these arguments is related to the agronomic potential of REUSE, TWW being defined as a natural input likely to replace costly chemical inputs. Research is being carried out to determine this potential. As REUSE is assessed to be beneficial, the research aims at addressing obstacles, like social acceptability and cost. To meet this challenge, experimental research is stepping outside its area of competence, or coming close to it. Is TWW socially acceptable? At what cost? For both sites, the studies are carried out by consultants who define the scope of their studies in line with the project consortium's request. On the Rur'eaux site, different scenarios are compared depending on the treatment chain applied to the wastewater. A cost-benefit analysis combining purification and financial performance based on an estimation of investment and operating costs was developed. On the Irrialt'eau site, the economic evaluation aims to guarantee the profitability of the REUSE for the future TWW beneficiaries (winegrowers, mostly new irrigators). The social dimensions are addressed by a social psychology approach, whose aim is to assess the acceptability of TWW for stakeholders involved in the winemaking sector (winegrowers, co-operators, traders, distributors, consumers) in the case of Irrialt'eau, and to avoid its rejection.

4. Limits and Credibility of REUSE

The critical rereading exercise enabled researchers to understand several limitations inherent in any production of knowledge, which, in the case of our study, reveals how fragile REUSE's credibility is. These weaknesses relate in particular to the long-term and environmental risks of the practice, and to the agronomic and economic potential of TWW.

Here are a few examples to illustrate these limitations. The first relates to TWW salinity, whose concentration can disrupt the agronomic system. The salt accumulation process in the soil can generate hydric stress and toxicity for crops, as well as degrading soil structure and biodiversity. The experimentation shows that this risk is not specific to wastewater treatment plants located in coastal areas. In fact, if the electrical conductivity at the Irrialt'eau and Rureaux sites is significant (between 1 and 1.5 dS/m), there are occasional very high peaks at Rur'eaux, not located in a coastal area (> 4.5 dS/m for periods of less than 2 hours). The salinity problems common to both sites suggest that soil salinity accumulation should be monitored over the long term, irrespective of wastewater treatment plant location and intended agricultural use.

The second example relates more specifically to REUSE's agronomic benefits. The assumption of savings through TWW use as an input is uncertain, as TWW nutritional contribution is very much conditioned by the irrigation strategy (quantity of water, frequency, irrigation method, time of year), itself designed as a function of soil type, plant strength, crop or climatic conditions. The irrigation strategy aims above all to meet the crop's water needs, since water needs do not necessarily coincide with nutritional needs.

A third example concerns the REUSE economic model. As the service provider points out, economic study is not sufficient to assess the global economic interest of the project, even if it is essential to validate the feasibility of the Irrialt'eau project and to allow future members to create a collective organization in charge of future TWW management. It would be necessary to collect data on wine irrigation practices using conventional raw water, in order to be able to compare the two types of water (TWW and conventional raw water) and thus determine the real added value of TWW. Similarly, scenarios 'without irrigation water' should complete the analysis, to check whether irrigation provides a real added value to the region.

One last example is the assessment of REUSE's beneficial effects on the environment, studied using a life-cycle analysis method, providing an overall environmental assessment of REUSE uncorrelated with the ecosystem's local conditions. The cost of acquiring data complicates empirical studies.

The identified limits are inherent to the experimental conditions. Metrological constraints shape knowledge, whether in terms of extracting substances (carbamazepine), detecting them (measuring instruments), quantifying them or measuring them (cost). The hazards associated with the experimental conditions (slugs, rain, falling temperatures, etc.) challenge the established protocols (attribution of observed effects, duration of experimentation, etc.).

Finally, the disciplinary and engineering backgrounds of the people involved in the experimental sites leave some questions unanswered. For example, 'is REUSE dangerous for humans?' remains an open question. In fact, indirect approaches are used to assess the risks, by noting the presence/absence of pathogenic molecules in different matrices (soil, plant, groundwater), rather than assessing the environmental and health risks, something inherent in ecotoxicology or toxicology. Other standards systems are used to compensate for this shortcoming. For example, the tests carried out on Irrialt'eau showed the presence of a pesticide (diuron) in the TWW. Its concentration was below the threshold applied to drinking water, leading to the conclusion of no risk. Is the company prepared to allow TWW to circulate? In the absence of a sociological study (and the experimental framework), the conditions under which potentially dangerous water is put into circulation have not been studied, nor have the conditions under which it is reallocated between users, and between society and the environment.

Further work will involve studying knowledge circulation in specialized arenas and public debate, in order to understand the role of demonstration sites in building REUSE credibility as a solution to water scarcity.

Bibliography

Bonneuil, C., 2000. Development as experiment: science and state building in late colonial and postcolonial Africa, 1930-1970. Osiris. 15, 258-281.

Cardona, A., Lefèvre A., Simon S., 2018. Les stations expérimentales comme lieux de production des savoirs agronomiques semi-confinés : Enquête dans deux stations INRA engagées dans l'agro-écologie. Revue d'anthropologie des connaissances. 12, 139-170.

Haraway, D., 1985. A manifesto for cyborgs: : Science, Technology, and Socialist Feminism in the 1980s. Socialist Review. 80, 65-107.

Hubert, M., 2015. Entre mutualisation des infrastructures et diversité des usages. Le travail de mise en plateforme dans les micro- et nanotechnologies. Revue d'anthropologie des connaissances. 9, 9-4. https://doi.org/10.3917/rac.029.0467

Rosental, C., 2009. Anthropologie de la démonstration. Revue d'anthropologie des connaissances, 3, 233-252.

Stengers, I., 2013. Une autre science est possible ! Les empêcheurs de penser en rond, La découverte, Paris.

Woolgar, S., Latour, B., 1988. La vie de laboratoire. La production des faits scientifiques. Editions La Découverte, Paris.