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ÉCONOMIE DU DÉVELOPPEMENT DURABLE
ET DE L'ÉNERGIE

Modernisation of urban water services management in Europe and prospects for sustainability

An analysis in terms of institutional resource regimes

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Modernisation of urban water services management in Europe and prospects for sustainability: an analysis in terms of institutional resource regimes

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Abstract:
This article assesses the sustainability potential of the urban water sector in Europe following its modernisation. The analysis uses the theoretical framework of institutional resource regimes. This interpretative framework provides us with a typology of natural resource governance systems based on their coherence and their extent. Then, based on the interplay of hypothesis and conjecture, the framework is used to deduce the capacity of a regime to provide sustainable governance. We conclude that modernisation offers a path for progress which though necessary is not sufficient. This pessimistic assessment is based mainly on the observation of a lack of coherence in urban water systems in Europe. The study is divided into three parts: description of the modernisation process; presentation of the interpretative framework used in analysing institutional resource regimes; application of the framework to the urban water sector in Europe.

Institutions play a determining role in the performance of a particular economic sector. The modernisation of the urban water sector in Europe provides an example of a regulation/re-regulation process implemented within an institutional framework. This case is specific because of a strong environmental constraint on the governance process. It offers an illustration where governance and sustainability meet.

More precisely, public authorities provide urban water governance through standards and public policies. Analysis of this governance has already led to the definition of a European model of water management and the identification of its constituent parts in terms of national variations (Correia, 1998; Finger *et al.*, 2007; Grossi *et al.*, 2010; Ménard and Peeroo, 2011). For two decades, this institutional framework has been evolving in order to meet the requirements of the sustainability objective (Kallis and Butler, 2001; Barraqué, 2003, 2012; Wright and Fritsch, 2011). Instrumental in this institutional change has been the emergence of new technical standards, the Urban Waste Water Treatment Directive (UWWTD), and the Water Framework Directive (WFD). Following this re-regulation of the urban water sector, the question of the effectiveness of these changes needs to be examined. To gain insights in this area we adopt an approach in terms of urban water systems in Europe (UWSE), which provides us with a broader subject of study than the classic definition of the urban water sector used in economics (Bolognesi, 2012). A UWSE provides a means of interaction between the stakeholders in an urban water cycle and the institutions that coordinate them. This approach puts the institutional dimension of governance at the heart of the system and takes into account the interactions between the standard economic characteristics and the institutional components.

The approaches used in rational choice institutionalism provide an analytical framework capable of taking these interactions into account but they avoid the conflict dimension of urban water uses and do not adequately address the question of sustainability (Ostrom, 1990; Ostrom *et al.*, 1993; Saleth and Dinar, 2004, 2005, 2008; Ménard and Peeroo, 2011). The approaches adopted in historical and/or sociological institutionalism reintegrate conflictual aspects into the analysis but their contingency dimension reduces the predictive power of the results (Klink and Petit, 2005; Zuindeau, 2007; Renou, 2010). We therefore use an alternative approach based on institutional resource regimes (IRR) that has been developed with a view to determining the potential for sustainability of regulation of natural resources (Kissling-Näf and Kuks, 2004; Knoepfel, 2007; Gerber *et al.*, 2009; Garin and Barraqué, 2012). This interpretative framework provides us with a typology of natural resource governance systems based on their coherence and their extent. Then, based on the interplay of hypothesis and conjecture, the framework is used to deduce the capacity of a regime to provide sustainable governance. **The IRR approach thus makes it possible to determine to what degree UWSE modernisation leads to a form of governance conducive to producing a sustainable path.** Results of the analysis show that the modernisation of urban water systems in Europe does not lead to sufficient change in urban water management to achieve a sustainable process. This pessimistic assessment is based mainly on the observation of a lack of coherence in urban water systems in Europe.

To better understand how the study reaches this conclusion, the present paper is divided into three parts. The first part reviews the underlying principles and the development of the governance framework for the UWSE. The second part presents the analytical grid used in examining the IRR, while the third part assesses the sustainability prospects of European urban water systems.

I. THE COMMON CHARACTERISTICS OF UWSE MODERNISATION: TECHNICAL STANDARDISATION AND LIBERAL GOVERNANCE

The impact of the European Union on urban water system management in Europe is becoming increasingly marked, particularly following the introduction of the subsidiarity principle. European regulation is becoming an increasingly significant factor in national water rights in EU countries and is thus one of the main components of UWSE management. This regulation was formally introduced on 6 May 1968 with the first European Water Charter and has undergone several phases in its development (Fig. 1). Thus, analysing the development of regulation enables us to characterise the modernisation process dealt with in this article. In our analysis of the different chronologies dealing with European regulation of water resources and associated activities (Kallis and Butler, 2001; Kaika, 2003), we refer in particular to the study by Allouche *et al*. (2008). This chronology is based on the European research programme *Euromarket* (2003-2005) and brings it up to date. Furthermore, this approach to the subject differs little from that used in the other analyses cited. European regulation can be divided into three phases, or generations: [1973-1988]; [1988-1995]; [1995- present day]. The third phase represents the modernisation discussed in this article.

During the first regulation phase, the European Union introduced rules aimed at controlling the quality of the resource and limiting the impact on uses, mainly through drinking water standards and pollution thresholds. This type of regulation controls the immission of polluting substances[1], and is in line with two of the European political objectives of that time: harmonisation of environmental rules, with a view to facilitating trade in particular, and protection of public health (Kallis and Nijkamp, 2000). The rules resulting from the second phase continued this effort and completed it by dealing directly with the sources of pollution and targeting specific sectors (urban water, etc.). Regulation took the form of a command and control system focussing then on the sources of emissions that degrade the resource. This pollution control was aimed at meeting environmental protection objectives and not simply with protecting uses. It should be noted that these two generations of regulations are anthropocentric, even though the second leaves a little more room for environmental concerns (Euromarket, 2003).

Finally, the third and current phase of regulation represents a paradigm shift with respect to the preceding periods. Rather than continuing to manage the resource and its uses in a selective and sector-based manner, the European Union began to promote integrated water resources management (IWRM). The objectives remain environmental but achieving them must remain compatible with the development of human activities. The implementation of means to achieve sustainable development is at the heart of this generation of regulations, and the European Water Framework Directive (WFD) spells out the fundamental principles.

[1] "Immission" refers to the concentration of pollutants in the water, while "emission" refers to the action of diffusing pollutants in the water. In the first case, emphasis is on the host environment of pollutants; in the second, it is their source.

Fig. 1: Main laws and regulations concerning water standards enacted at European level

Text	Year	Objective
Generation 1		
European Water Charter	1968	1st European instrument dealing with water
Directive 75/440/EEC	1975	Surface water
Directive 76/464/EEC	1976	Dangerous substances
Directive 80/68/EEC	1980	Groundwater
Directive 80/778/EEC	1980	Quality of water intended for human consumption (revised by 98/83/EC)
Generation 2		
Directive 91/271/EEC	1991	Urban waste water
Directive 91/462/EEC	1991	Guidelines for a pan-European water resources management policy (supply and quality)
Directive 91/676/EEC	1991	Nitrates from agricultural sources
Recommendation 1224	1993	Protection and management of fresh water resources (this originated in the Freshwater Europe action programme)
Recommendation 1232	1994	Water resources and agriculture
Generation 3		
Directive 96/61/EC	1996	Integrated pollution prevention and control
Directive 98/38/EC	1998	Quality of water intended for human consumption
Resolution 1222	2000	Water resources and agriculture
Recommendation 1471	2000	Link between science and technology to balance supply and demand, especially in the Mediterranean basin.
Directive 2000/60/EC	2000	Water Framework Directive (amended by decision 2455/2001/EC and directives 2008/32/EC; 2008/105/EC; 2009/31/EC)
European Water Charter	2001	European water resources charter (replacing charter of 1968)
Directive 2004/17/EC	2004	Public procurement in the water, energy, transport and postal services sectors
Directive 2006/7/EC	2006	Quality of bathing water
Directive 2006/11/EC	2006	Pollution caused by certain dangerous substances
Directive 2006/118/EC	2006	Protection of groundwater
Directive 2008/105/EC	2008	Environmental quality standards
Directive 2010/75/EU	2010	Industrial emissions: Integrated pollution prevention and control

This chronology reveals a change in European regulations in both substance and form. European regulations on water developed firstly by taking into consideration specific problems as they arose (agriculture, quality, technology, urban water, etc.) and then proposing procedural rules. Following this, an effort was made to link the different problems so that a holistic approach to water management could gradually be put in place. Thus in 1991, Directive 462 drew up guidelines for pan-European water management which were followed by sectoral recommendations, such as in 1993 and 1994 with recommendations 1224 and 1232, dealing respectively with resource protection and water and agriculture. Again in 1991, the UWWTD imposed obligations regarding the collection and treatment of wastewater and acted directly on the management of UWSEs. In 2000, the WFD introduced new water management principles in Europe and became the main element in the third phase of the development of European regulations. Its novelty lay in the assumption of a positive

correlation between methods of governance, in particular those recommended by new public management, and protection of the environment (Fig. 2). However, the directive evolved in function of the constraints observed during implementation and was amended in 2001, 2008 and 2009.

Fig. 2: European principles of water management contained in WFD

1. "*Water is not a commercial product like any other, but, rather, a heritage which must be protected and defended".*
2. "*Sustainable use of water"*, "*take into account the vulnerability of aquatic ecosystems".*
3. Good quality, strengthening of water protection standards: "*good ecological status within a period of 15 years"* (any exception must be justified).
4. Quantity: calculation of minimum discharge of rivers, for example, on basis of amount of water that can be abstracted while respecting the requirements of aquatic areas (abandonment of water requirements of different users, industry, agriculture, drinking water, etc).
5. "*Polluter pays*" principle.
6. "*Water pays for water*" principle.
7. Governance based on districts corresponding to river basins or catchment areas
8. … based on user participation on catchment area committees.

Source: Gilles Massardier, 2011: 12.

In this article, we consider that the paradigm shift brought about by the third generation of regulations is providing impetus to the modernisation of urban water services in Europe. The study therefore focuses on this period and, among all the rules promulgated, gives paramount importance to the WFD[2]. The WFD is in line with an anthropocentric approach to sustainable development; it protects the resource both qualitatively and quantitatively but without neglecting economic efficiency. This ambition to integrate the three pillars of sustainable development is reflected in the essential principles of the directive such as integrated management based on river basins, attainment of good ecological status, and incentives to set up public-private partnerships (PPP). In addition, the WFD also breaks with the old European standards concerning methods of regulation. As illustrated by the objective of attaining good ecological status for the resource, management results remain important, but now management procedures are also imposed and recommended, such as implementation of the "polluter pays" principle (Moss, 2004). The modernisation of water management practices promotes a form of water governance that is no longer concerned only with protection of the resource and its uses.

In support of this observation, it may be noted that article 9.1 of the WFD states that "*water-pricing policies provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of this Directive".* The WFD uses economic incentives and market mechanisms to organise management of the sector. Modernisation of the water sector is a continuation of the movement to liberalise all network infrastructures begun in the 1990s (Finger *et al*., 2007). The structure of the market makes it difficult to ensure atomicity among suppliers in a limited spatial area. Thus, in Europe the search for efficiency in the water sector resulted in an organisation based on the theory of contestable markets (Baumol, 1982) and de-integration of the sector (Demsetz, 1987). The contestability of markets should ensure an optimal allocation of resources while de-integration would produce new spaces in which competition can take place. Operators

[2] All normative and preparatory acts, and those relating to water management and protection in Europe, can be accessed *via* http://eur-lex.europa.eu/fr/dossier/dossier_61.htm#1, consulted on 10-09-2012.

would become legal entities under private law, instead of and in the place of public monopolies.

UWSE modernisation is therefore based on a multiplication of technical standards ensuring preservation of the resource and protection of its uses as well as on a set of rules favouring the privatisation and liberalisation of the sector so as to improve the efficiency of governance. This modernisation may be seen as the combination of the pursuit of environmental objectives (protection and preservation) and rationalisation of the governance process (privatisation and liberalisation). The process gives impetus to two dynamics of urban water management in Europe: an increase in standardisation and a liberal approach. By reconciling these two dynamics, the European authorities hope to organise the sustainable management of urban water resources. We may therefore identify a common basis for a European model of water management, even though infra-European diversity may also be observed (between the German, French and English models). This diversity takes the form of variations of the European model and is reflected in the different institutional forms observed in the implementation of these shared principles (Finger *et al*. 2007; Ménard, Peeroo, 2011). Two factors explain the polymorphism of the European water management model: the different legal backgrounds of the countries concerned and the variety of definitions/perceptions of a public service (Lorrain, 2005).

Having presented the main characteristics of the modernisation of UWSEs, noting their common aspects as well as their variations, we will now take a closer look at the IRR research programme.

II. IRR RESEARCH PROGRAMME: COMBINING PUBLIC POLICY ANALYSIS AND ECONOMIC INSTITUTIONALISM

To obtain a clear understanding of the analytical framework of IRRs before applying it to UWSE modernisation, it is important to first examine its foundations (II.1), and then its capacity to describe (II.2) and predict (II.3).

II.1 ANALYTICAL BASES: AN EMPIRICAL AND THEORETICAL CRITIQUE OF ENVIRONMENTAL POLICIES IN EUROPE

The IRR research programme is underpinned by an empirical and theoretical critique of European environmental policies (Knoepfel and Nahrath, 2005; Knoepfel, 2007; Gerber *et al*., 2009). The empirical evaluation is based on the study on environmental history by McNeill (2000), which provides a diagnostic analysis of environmental degradation and the non-sustainable path of human development. Based on this historical analysis, the advocates of IRRs distinguish between different conceptions of environmental policies and point out the paradox that exists among them.

The first, so-called classical, conception is the least sustainable and *"confines itself to reasoning in terms of limiting the emission of pollutants"[Transl]* (Knoepfel and Nahrath, 2005: 207). The second conception attributes the objective of sustainable development to environmental policies: this involves reconciling the economic, ecological and social requirements relating to a resource. This type of policy represents progress in relation to the first approach, but it has proved to be not entirely satisfactory. "Sustainability policies" are focused on "*the conditions for allocating the quantities of resources exploited" [Transl]* with a view to meeting the requirements mentioned above (*idem*: 207). This logic presupposes a fairly abundant quantity of resources to ensure the production of goods and services demanded. In addition, as we have seen with the classical approach to policy, standards only restrict immissions and emissions of pollutants. Consequently, an "*ecologically clean*

overexploitation of the resource" [Transl] may occur and the development path of different uses may become non-sustainable (*ibidem*: 208). Following criticism of the environmental policies resulting from these two conceptions, a third conception was proposed in order to genuinely coordinate uses in a sustainable manner. The authors maintain that the effectiveness of environmental policies hinges on the distinction between resource sustainability and resource use (Gerber *et al*., 2009). We refer to this third conception by using the term "distinctive sustainable policies".

From a theoretical standpoint, a public policy approach comes up against one major limitation. It only considers the resource through sectoral analyses that are independent of each other, so that it is difficult to obtain an overall understanding of resource problems (Knoepfel and Nahrath, 2005; Knoepfel, 2007; Gerber *et al*., 2009). This limitation stems from the actual conception of public policies that tend to separate the issues identified. Institutional economics provides an analytical framework for identifying the links between different public policies, namely through notions of coordination and institutional arrangements. Based on the work of Bromley (1991, 1992) and Ostrom (1990, 2002), the IRR research programme postulates that there is compatibility between the analysis of public policies and institutional economics. Enhanced by the complementarity of the two approaches, the research programme goes beyond the theoretical limits outlined above.

These opening remarks help characterise the IRR approach. It is an approach combining public policy analysis and institutional economics that is specific to the study of natural resources management. More particularly, it questions the sustainability of the management practices used for a resource and related goods and services. Its axiomatic nature limits the field of study to those territories in which the formal rules are the principal source of regulation, in other words essentially the OECD countries. This focus on the written rule makes it possible to identify the main factors motivating and governing the choices of actors participating in UWSEs (Bolognesi, 2012). Furthermore, the work of the AFD, the French Development Agency, using data on national institutional profiles, confirms the relevance of restricting the analysis to the formal rules in OECD countries by showing the high degree of formalisation of regulation systems (Meisel and Ould-Aoudia, 2007).

II.2 Objective of IRRs from the perspective of positive economics: identification of ways of regulating a natural resource

An IRR is a means of governance of the uses of a given natural resource in a defined territory. In other words, it is the sum of public policies and property rights regulating the uses of a resource (Kissling-Näf and Kuks, 2004; Knoepfel and Nahrath, 2005; Gerber *et al*., 2009). In terms of positive economics, the objective of IRRs is to identify the governance mechanisms at work in regulating a natural resource. Consequently, it focuses on public policies and the structure of property rights. All these regulatory instruments are brought together in the two components of an IRR, respectively the policy design and the regulatory system for public policies and property rights. The weight of the two components in the regulation structure varies from one IRR to another, making it possible to distinguish between regimes that are organised essentially through the structure of property rights and those for which public policies are the main means of coordination.

Policy design comprises six elements and public policies give it concrete form (Knoepfel and Nahrath, 2005). The six elements are as follows:

1. Definition of problem and collective objectives;

2. Causality model[3];
3. Public policy stakeholders: targets, beneficiaries and political and administrative actors;
4. Policy instruments;
5. Political and administrative arrangements;
6. Outputs.

Policy design results in the formulation of a public policy that will impact on the uses of the resource. In the context of IRRs, an understanding of public policies is obtained via a study of public law[4], considered to be the formal manifestation of public policies. Finally, policy design and public policies help define use rights for the resource. The second component of an IRR, the regulatory system, groups together formal property rights over the resource as well as the use and disposal rights which result from these[5]. Private law[6], corresponding to the French civil code, is a formal manifestation of the rights of the regulatory system. Thus, property rights come from the regulatory system while usage rights are jointly defined by the regulatory system and policy design (in general, public policies limit or refine the usage rights allocated.

The possibilities for combining these two components are numerous and four different ways of regulating resources can be identified (Knoepfel and Nahrath, 2005; Gerber *et al*., 2009), based on the impact of the policy design and the regulatory system on property and usage rights. Type 1 regulation has no impact on the system of rights and essentially involves the creation of incentive mechanisms. Type 2 has a limited impact on the structure of rights through the use of *ex post* specifications or restrictions on the allocation of rights. Type 3 modifies the breadth and content of rights through a redefinition of the institution of formal property, for example, via an amendment to the civil code. Finally, type 4 procedures redefine the allocation structure of property titles, for example through privatisation.

II.3 OBJECTIVE IN TERMS OF NORMATIVE ECONOMICS: DEFINITION OF AN INTEGRATED IRR FOR SUSTAINABLE GOVERNANCE

The normative objective of IRRs is to formulate recommendations to improve the sustainability of resource regulation systems. The procedures for attaining this objective are logically structured around three analytical steps: identification of the scope of an IRR, its classification, and the formulation of hypotheses linking the characteristics of an IRR to its sustainability potential. The notions of "extent" and "coherence" define the scope of an IRR. The extent refers to the number of goods and services regulated by an IRR at any given time. To evaluate it, these goods and services have been listed for different natural resources, including water (Knoepfel *et al*., 2001). The ratio between the extent observed and all the goods and services used gives the relative extent of the IRR. When the ratio is less than 1, it indicates the possibility of non-regulated rivalries, while a ratio of above 1 suggests over-

[3] A model of causality identifies the actors responsible for the problem of collective action and the mechanisms capable of modifying their behaviour in the manner recommended by element 1. The model also takes into account element 3 (stakeholders) and 4 (instruments) of the policy design.

[4] The authors are aware that the distinction between *private* and *public law* appears clear in traditional Roman law but less so in *common law* legal systems (Knoepfel and Nahrath, 2005; Varone *et al*., 2008; Gerber *et al*., 2009).

In legal systems based on Roman law, *public law* governs interactions between private actors and the State.

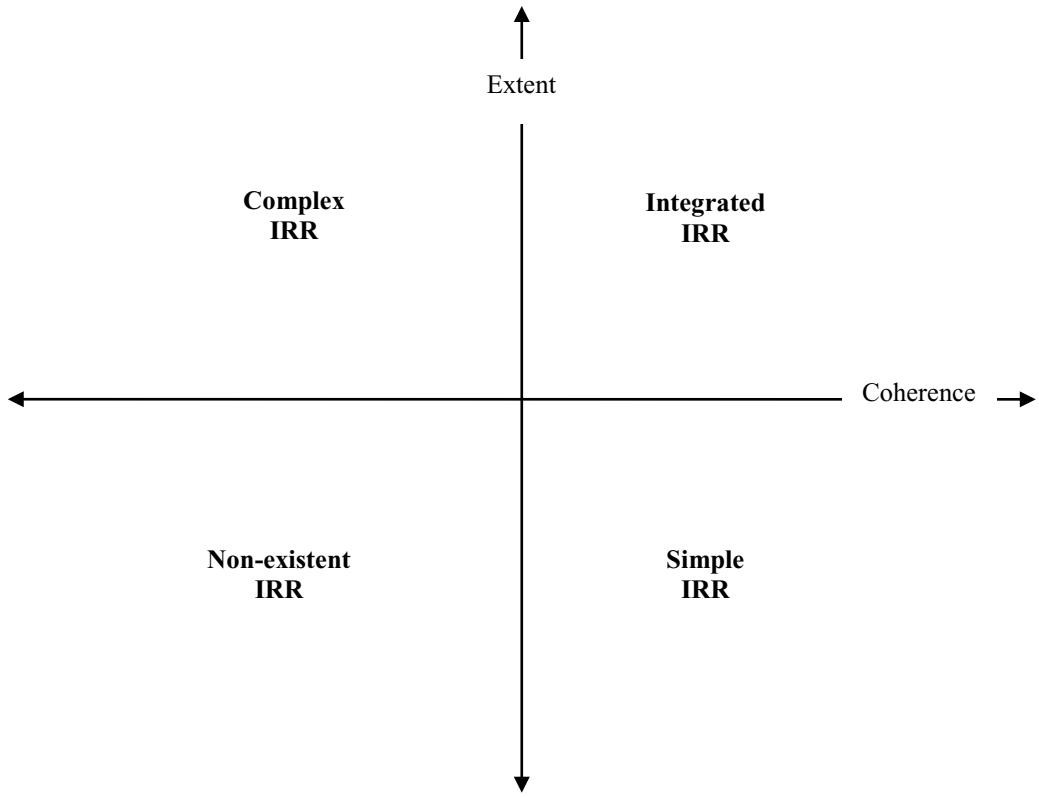
[5] Roman law distinguishes between right of disposal and right of use (*usus*, *abusus*, *fructus*). The right of disposal, (right to sell – *abusus*) applies to the transfer of the resource, while *usus* refers to the right of use and the prerogatives relating to the modification of the resource contained in the *abusus*.

[6] In legal systems based on Roman law, *private law* governs interactions between private actors.

regulation. The coherence of an IRR relates to the content of the different sources of regulation of an IRR and the coordination between them (Gerber *et al*., 2009). Three forms of coherence may be distinguished. Coherence within the policy design ensures compatibility between its six elements, on the one hand, and between the different public policies on the other. Coherence within the regulatory system means that property rights are clearly defined and non-contradictory. Finally, external coherence reflects a satisfactory link between the two components of the IRR, for example correspondence between target groups and holders of rights under the regulatory system.

Based on the extent and coherence characteristics of an IRR, a typology can be proposed distinguishing four possible IRR forms: non-existent, simple, complex and integrated (Kissling-Näf and Kuks, 2004; Knoepfel and Nahrath, 2005;Knoepfel, 2007; Gerber *et al*., 2009) (Fig. 3). A non-existent RIR indicates the absence of any form of usage regulation for the resource. A simple IRR reflects emerging regulation for a resource, where only a limited number of goods and services (among those actually used) have so far been regulated, but in a coherent manner (the sources of incoherence being reduced). An IRR becomes complex when most of the goods and services used are regulated but in a way that is not very coherent. Finally, an integrated IRR indicates the coherent regulation of all the goods and services used. Empirical evidence shows this form occurs mainly when regulation is public or is administered by a powerful stakeholder representing collective interests (Knoepfel and Nahrath, 2005). Each IRR studied is classified according to this typology.

Fig.3: Typology of IRRs according to their extent and coherence



Source: Gerber *et al*., 2009 : 806.

Finally, and in our opinion this represents the major contribution of the IRR, conjectures may be made on the causality between the extent and coherence of an IRR, on the

one hand, and the sustainability potential, on the other[7]. The first conjecture suggests that the move towards an integrated form increases the potential for sustainability and leads to two sub-conjectures, each specific to the extent and coherence of the IRR. The second conjecture relates to the evolution of an IRR. It establishes a positive causality between the level of threat to a resource, its perception as an issue of collective action and, consequently, the expansion and greater coherence of the IRR. This interplay of conjectures completes the normative objective of the research programme of the IRRs, by which the sustainable use of a resource is attained through an increase in the extent and coherence of regulation. The approach thus makes sustainability a central objective in the governance of a natural resource and supports the need to build an integrated IRR.

Having presented the subject of analysis and the theoretical elements, we will now re-integrate empiricism in the analytical framework with the aim of gaining insights into the prospects for sustainability of UWSEs following their modernisation.

III. THE LIMITED SUSTAINABILITY POTENTIAL OF UWSES: COMPLEX IRRS

Identification of the scope of UWSEs helps evaluate their potential for sustainability. Extent appears large (III.1) while coherence seems to be insufficient (III.2).

III.1 MODERNISATION AS A STEP TOWARDS SUSTAINABILITY: A FACTOR IN THE EXPANSION OF UWSES

By interpreting UWSE modernisation by means of the analytical framework presented earlier we conclude firstly that the extent of the UWSE is large and, secondly, that two different processes are at the origin of this large coverage (Fig. 4). The first process relates to the classic development of technical standardisation, which we refer to as *expansion through regulatory measures*. The second process concerns the change in the form of urban water supply services, which we qualify as *processual*. We will now discuss this expansion in terms of both its form and dynamic.

Technical standardisation of water uses meant that the extent of UWSEs was increased as a result of the introduction of regulatory measures. This dynamic process stems from the multiplication of standards on processes, emissions and immissions, produced essentially by the public authorities with a view to regulating water uses and their impacts (Barraqué, 2003). By looking at the timeline of European regulations we can see the direction taken by the regulatory process and the change in the actual purpose of control measures. Originally, technical standards served as health objectives and, generally speaking, restricted the immission of polluting substances into the resource. Following this, an environmental objective to protect the actual resource, with corresponding emission standards, was introduced, leading to a further increase in extent. At the same time, the identification of particularly sensitive areas encouraged the creation of technical standards specific to targeted sectors, as illustrated in the tables of the UWWTD in the Appendix. Finally, during modernisation, the attempt to harmonise practices, etc., resulted in the emergence of

[7] In our opinion, and based on the epistemology of Lakatos (1978), these conjectures constitute both a cornerstone and a stumbling block of the research programme, a cornerstone because they establish the originality and the major contribution of the *corpus*, and a stumbling block because, given that the conjectures are not demonstrated, the normative and predictive objective of the IRRs appears unstable. However, experience has neither refuted the conclusions nor falsified the research programme. This therefore enables us to use IRRs with caution. The apparent shortcomings of the research programme are a reflection of its relatively recent beginnings and indicate that it is still maturing, while the development of its positive heuristic constitutes a major element in its future progression.

procedural standards governing actual uses (obligation of water treatment techniques, for example) and no longer simply objectives in terms of results. In addition, the reason for control measures has also evolved. Increased market power and the presence of private actors in the supply of urban water services forced public authorities, in a more systematic manner, to supervise activity by means of standards in order to remedy any possible negative externalities and to maintain general interest in the resource.

The second dynamic whereby UWSE regulation is increased, which we call *processual expansion*, is a direct consequence of the application of the principles of governance incorporated in the modernisation process. Thus, modernisation gives impetus to changes in UWSE regulation methods, two of which appear essential. First, the encouragement given to PPPs, and to privatisation in general, led to a redefinition of the allocation structure of property rights (type 4 regulation), the privatisation of English RWAs in 1989 being the most symptomatic example. Second, generalisation of the use of economic instruments with a view to "rationalisation" of management increased the importance of type 1 regulation in UWSE governance. The modification in substance or form of these two types of regulation encouraged the liberal orientation of modernisation, as underlined in the first part. It attributes increasing importance to the market, but coordination through the market implies recourse to formal regulation.

Market trading requires firstly the existence and/or definition of property rights and then takes place by means of contracts drawn up between the stakeholders. Thus we maintain that liberal regulation and market supply of urban water services in essence increases the goods and services formally regulated in UWSEs. In this sense, modernisation of UWSE governance increases the extent of the IRR by its very nature. In particular, it results in a high relative extent since all the good and services used will be formally regulated by the market.

Fig. 4: The two dynamics of expansion contained in the modernisation of UWSE

	Expansion through regulatory measures	Processual expansion
Definition	Increase of binding rules issued by public authorities	Increase of rules related to the implementation of governance principles
Sources	-Public intervention (welfare state) -Control on UWSE economic activity	-Implementation of coordination conditions different from authority
Operating mechanisms	-Formulation of technical standards, *etc.*	-Property rights formalization -Contractual coordination
Types of regulation concern	Type 2	-Type 4 (mostly) -Type 1
Impact on extent	Absolute extent	Relative extent: uses require existence of specific rules

Knowing that the extent of urban water systems in Europe is high makes it possible to better characterise them using the IRR typology and to provide an interim opinion on their sustainability potential. First, among the four forms of IRR, only the complex and integrated types have a high extent. UWSEs therefore belong to one of these two categories and the forthcoming analysis of their coherence will enable us to determine which one. Second, by

virtue of conjecture 1.1 linking extent and sustainability, we may assume that modernisation exerts a beneficial effect on the sustainability of a UWSE by increasing its extent and ensuring a high degree of relative extent. Thus far, the coherence dimension is decisive in determining the overall sustainability potential that modernisation confers on the UWSE.

III.2 Persistence of inconsistencies in regulation as a limit to integration of the IRR

Analysis of IRR coherence involves studying the coherence of both policy design and the regulatory system, as well as their cross-coherence. To carry out this analysis, we sought to identify inconsistencies and malfunctions. Ultimately, the results confirm the conjecture that inconsistencies subsist despite the acknowledged modern-day attempts to put an end to these limits to sustainability by harmonising European water management principles.

The regulatory system appears to be the most coherent component of UWSEs, which can be largely explained by the choice of study area. As pointed out in the opening remarks of the second part, European territories are particularly suited to an analysis in terms of IRR thanks to the mostly formal regulation systems. This long tradition of coordination around property rights has made it possible to put in place a set of institutions and organisations capable of ensuring the coherence – in the IRR sense – of the regulatory system. The development goes with the development of the rule of law and the public bureaucracy (Brousseau, Schemeil and Sgard, 2010: 254). Nevertheless, it should be stressed that internal coherence of the regulatory system is not necessarily equivalent to stable and clear management at the time of interaction between stakeholders. Indeed, the multiplication of stakeholders also generates uncertainty in strategic areas and the possibility of conflict, but thanks to internal coherence such problems can be settled subsequently. The analyses of Bakker (2000; 2010) on the privatisation of the English sector illustrate this remark, as does, in a more concrete fashion, the management of the 1995 drought in England[8].

The policy design of UWSE modernisation suffers from more internal inconsistencies than the regulatory system. The two main indicators are the debate on how to attain good ecological status and, more generally, how to ensure conformity of local management systems with European directives. The objective of achieving good ecological status of water by 2015, in which urban uses will play a major role, appears difficult to reach[9]. In addition, scientists are voicing reservations on the methods of measuring efforts and the results achieved with respect to their rigour, diversity and comparability, with the classification of certain water bodies being re-examined (Hering *et al.*, 2010; Beniston *et al.*, 2012). It is also true to say that ensuring conformity with management methods recommended by the WFD is not always an easy matter (Wright and Fritsch, 2011), as we saw for example with German reticence towards privatisation. Thus, coordination between the different levels of UWSE governance is characterised by malfunctions that reduce the coherence of the policy design for modernisation. Nevertheless, mention should be made of the European readjustments: the WFD has been amended three times, going so far as to bring more flexibility to external funding possibilities in the water sector.

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[8] This drought revealed that the system of price-capping had not encouraged operators to invest sufficiently in infrastructure development so as to maintain the balance between supply and demand (Bakker, 2000). Later, the regulatory authorities and the State sent out new price signals to remedy this shortcoming.

[9] All the reports of member countries of the European Commission are available at: http://www.eea.europa.eu/themes/water/reporting-obligations, consulted on 27-09-2012. For France, in particular, the reader may consult: http://www.rapportage.eaufrance.fr/; for England: http://www.environment-agency.gov.uk/research/library/data/97343.aspx; for Germany, the report is available at: http://www.umweltdaten.de/publikationen/fpdf-l/3771.pdf.

The main sources of inconsistency in UWSEs lie at the interface of policy design and the regulatory system[10]. All the differences between the States and the European Commission testify to these external inconsistencies. Representing about 20 % of disputes, water is one of those areas that are most in breach of European environment legislation (Keller, 2011). The United Kingdom (56) and Germany (57) are guilty of fewer infractions than France (74), while Belgium has the worst record with no less than 109 infractions reported in December 2010. To have an idea of the risks incurred, the penalties relating to French case C-280/02 concerning urban waste water were estimated at several hundred million euros (Keller, 2007).

The degree of coherence of UWSEs is not high, mainly because of the difficulty of organising a harmonious and multi-level policy. This lack of coherence appears in particular externally, a fact also noted by stakeholders. Members are therefore making a concerted effort to increase coordination among the different elements of UWSE regulation. By knowing the scope of a UWSE, we are able to deduce the type of IRR that it belongs to and the potential for sustainability that modernisation would provide.

III.3 EXPANSION *VERSUS* COHERENCE: THE PARADOX OF MODERNISATION

On the basis of the characteristics defining the scope of UWSEs, i.e. large extent and poor coherence, we are able to deduce the type of IRR to which they belong. The large extent eliminates the possibility of "non-existent" or "simple" types of IRR and the low level of coherence makes an "integrated" IRR unlikely. Consequently, the modernisation of water management in Europe is helping to shape UWSEs as "complex" IRRs (Fig. 5). The hypotheses relating to IRR sustainability suggest that complex IRRs are regulated by a governance system that does not maximise sustainability potential. Thus, as things stand, modernisation would not ensure that UWSEs develop with maximum sustainability potential. This conclusion rests on the ambivalence of modernisation. We should therefore emphasize the effects, both positive and negative, of expansion through regulatory measures and processual expansion on the sustainability of UWSEs.

[10] This is also because these inconsistencies are the most visible and identifiable.

Fig.5: Classifying UWSE as complex IRR

	Low coherence	High coherence
High extent	Complex IRR Impact of modernization on UWSE: -multiplication of formal rules (standards, contracts, *etc.*) -technical complexity -decentralization and self-reliance of behaviors	~~Integrated IRR~~ Inconsistent with the low coherence of UWSE: -difficulties to implement multi-level governance -organizational frictions -mild and variable efficiency of incentives
Low extent	~~Non-existent IRR~~ Inconsistent with the high extent of UWSE: -strong technical standardization -property right formulation ..-multiplication of contractual relations	~~Simple IRR~~ Inconsistent with the low coherence of UWSE: -difficulties to implement multi-level governance -organizational frictions -mild and variable efficiency of incentives Inconsistent with the high extent of UWSE: -strong technical standardization -property right formulation ..-multiplication of contractual relations

Expansion through regulatory measures increases the total amount of regulated goods and services, which directly improves the sustainability potential of the systems. However, it reduces this potential by making the system more complex. This regulation through standards increases the technical complexity of supplying the services, which results in a reduction in system coherence. Operators find it difficult to integrate such regulation into their systems. In addition to this technical aspect, ensuring conformity entails a financial cost that may threaten the internal coherence of the policy design and the external coherence of UWSEs[11]. Faced with these additional costs relating to technical standardisation, the supervision and rationalisation of governance processes stemming from procedural regulations reduce the sources of financing. The principles of full cost recovery and "water pays for water" are examples of this problem (Barraqué, 2003). Thus, while costs increase, financing possibilities decrease, and the question of investment in infrastructure becomes a major problem in UWSE management. There is therefore an area of friction between the technical component and the economic/institutional component of expansion through regulatory measures. This friction causes regulatory incoherence and eventually diminishes the sustainability potential of UWSEs. Moreover, expansion through regulatory measures reinforces the tension between the socio-environmental and economic objectives required to achieve a sustainable management system for urban water services in Europe.

[11] This cost is not negligible since it represents the majority of the increase in costs for suppliers. It comes mainly from the introduction of sanitation standards and the increasing complexity of drinking water treatment procedures in order to comply with regulations.

Processual expansion has a similar effect on the sustainability of UWSEs. By recourse to property rights and contracts, it increases the extent of the system, ensures a relative extent that is at least equal to 1, and improves sustainability potential. This recourse, however, decreases UWSE coherence because of the characteristics of coordination through the market, and reduces sustainability potential. Thus, institutional economics considers that property rights and contracts are incomplete (Barzel, 1982; Brousseau and Nicita, 2010). This incompleteness implies an inability to take into account all the possible developments and changes in transactions and does not totally eliminate uncertainty. Coordination through the market does not eradicate *ex ante* uncertainty, so that contracts require readjustments and safeguard mechanisms must accompany contracts and property rights. This uncertainty leads to difficulties in organising the different elements of regulation and is a hindrance to the achievement of IRR coherence.

It appears that the positive impact of expansion processes is counterbalanced by the appearance of inconsistencies that weaken the sustainability potential of UWSEs. In this respect, modernisation has a paradoxical effect on the sustainability potential of UWSEs. On the one hand, modernisation increases the extent of UWSEs by means of regulatory and processual expansion, while on the other hand the way in which these two mechanisms function generates inconsistencies and prevents complete integration of UWSEs. It therefore appears, at first sight, that modernisation develops the sustainability potential of water management in European cities by producing rules that add substance to system regulation. However, a more detailed look reveals that the costs of coordination associated with these rules do not seem to be taken into account in modernisation in its current form. This paradox limits the sustainability potential of management systems for urban water services in Europe.

CONCLUSION

The modernisation of UWSEs is characterised by an increase in technical standardisation and a liberal trend in governance. This article evaluates the capacity of this modernisation process to direct the UWSE along a sustainable development path. With this aim in mind, we used the analytical framework of the IRRs to assess the sustainability potential of UWSEs according to their extent and their coherence. The analysis reaches two main conclusions, the first positive, the second negative.

First, UWSEs figure among the complex IRRs. We show that modernisation allows *expansion through regulatory measures and processual expansion* of UWSEs, which means that the "extent" dimension is high. However, UWSE modernisation is subject to malfunctions and does not manage to ensure a sufficient level of coherence to reach the status of an integrated IRR. We identify the main sources of this low level of coherence as being related to the coordination between policy design and the regulatory system, the prime cause of which is the difficulty of setting up a multi-level governance system. Second, modernisation will not provide UWSEs with a guarantee of sustainable development. The complex status of UWSEs means that, according to the conjectures relating to IRRs, sustainability potential is limited. Admittedly, since the extent dimension is high, there is less chance of any unsettled conflicts over use, but the lack of coherence reduces the effectiveness of regulation resulting from implementation of public policies and of the property rights system.

Ultimately, the Europeanization of this public service does not seem to be an adequate solution to the problems of sustainability facing urban water systems in Europe. Moreover, it raises the more general question regarding the capacity of a governance system with a liberal

tendency to ensure a sustainable supply of natural resource-based services of general interest (Ostrom, 2010).

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