



# Institutional Resource Regimes: The Case of Water Management in Switzerland

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## ABSTRACT

The increased consumption of goods and services derived from natural resources has resulted in competing uses, increasing scarcity, and destruction of the resources stock. The use of such threatened resources can be institutionally influenced and managed by means of Institutional Resource Regimes (IR). An IR is a combination of ownership, disposition and use rights, and of resource-specific protection and exploitation policies. This article presents the theoretical IR concept and analyses the historical development of IRs for the water resource in Switzerland. In particular, it identifies those historical moments where the IRs actually changed, as well as the entire development trajectory of the IRs for the period 1870–2000.

**Keywords:** natural resource, water management, institutional regime, property and use rights, policy design, Switzerland.

## 1. INTRODUCTION

Any number of examples can be provided to demonstrate the ongoing degradation of natural resources. The use of such threatened resources can be institutionally influenced and managed with the help of *Institutional Resource Regimes (IR)*. As we understand it, an IR is a combination of formal property (ownership), disposition<sup>1</sup> and use rights, and the prominent elements of resource-specific protection and exploitation policies the design of which comprises specific aims with respect to preservation and use, the intervention instruments, institutional actor arrangements, etc. The central postulate of this new theoretical approach assumes that the two steering dimensions (“water rights system” and “policy design”) are complementary and must be taken into consideration in order to achieve sustainable resource management.

The starting point of our reflection is the question as to how institutional rules affect individual behaviour and collective resource management. The paper examines if and how IRs adjust to changes in the structures of users as well as to the increased use and scarcity of resources. By analysing (as a first empirical step) the historical development of IRs for water in Switzerland we gain initial insights

into the triggers of IR emergence and change. To be able to analyse the development of the different IRs, it is first necessary to define what is meant by a natural resource (Section 2) and the resource management deficits identified by traditional economic and political-scientific approaches (Section 3). On this basis, we identify the different constitutive elements of an Institutional Resource Regime (IR) and propose an initial typology of IRs and an ideal-typical presentation of various development trajectories (Section 4). These new theoretical concepts (basic elements, IR typology and development trajectory) are then explored on the basis of water resource (Section 5). In the final chapter (Section 6), we discuss the theoretical and practical usefulness of the proposed IR approach.

## 2. RESOURCE DEFINITION AND RESOURCE DEGRADATION

We define natural resources as natural and man-made components of nature that are important to people [2, 3]. Thus, socio-economic and cultural factors play a key role in what is and is not defined as a natural resource. The historical point in time and spatial reference (local, global) are also

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<sup>1</sup>We consider the “disposition rights” as the possibility for the formal owner to freely “dispose” of (parts of) the resource, that means to sell it, to give it, to rent it, etc. Disposition rights refer to the right to transfer specific use rights or to sell the resource itself. Most of water lawyers don’t consider such disposition rights and only distinguish the rights to own and the right to use (see for example [1]).

important here. A distinction is made between the resource stock and its fruit (or yield). When we refer to a natural resource, we intend both its stock and its yield [4].

The time taken for renewal provides information about whether it is a renewable or non-renewable resource. Depending on the existing resource stock, renewable resources can renew themselves within decision-making periods that are relevant to humans without targeted human intervention [5].

Resources provide different goods and services (Fig. 1). Resources give rise to either direct use (e.g., as input factors in production processes or the direct consumption option), indirect use (e.g., absorption sink for pollutants, ecosystem services) or immaterial use (e.g., in the form of landscape, amenity, aesthetic and cultural values) by humans [6, 7].

The resource situation can be characterised by the number of beneficiary groups and uses. It is very common for different beneficiary groups to compete for different uses [7]. A distinction is made between the formal owner (ownership rights), the appropriator (disposition rights) and the final consumer (use rights) of a resource. The disposal and use of the resource stock, the sustained yield and the goods and services based on the resource can be subject to different regulations with respect to law on property and use.

From an institutional perspective, it is significant that numerous uses, property and use rights and beneficiary groups exist. All of the institutional regulations which influence the behaviour of the different beneficiary groups and owners and their rights can be defined as elements of IR. Whereas owners have actual ownership of a piece of land and enjoy the rights associated with this ownership, appropriators have clearly restricted use rights relating to specific goods and services of a resource (e.g., concessions for the production of hydropower or for the withdrawal of groundwater). Final users are those

beneficiaries who actually consume the acquired goods (e.g., consumers of electricity or drinking water).

### 3. CONVENTIONAL APPROACHES TO RESOURCE MANAGEMENT

How can the degradation of natural resources and the destruction of the environment be halted? Institutional economics and political science have provided important contributions on this issue and we draw, in particular, here on the theories of property rights and public policy. Before proposing an integrated approach, we would like to present the remedies proposed by both traditional perspectives and explicitly examine some of their shortcomings.

#### 3.1. Property and Use Rights

Central economic concepts focus on the internalisation of external effects and the design of institutional mechanisms for coping with social dilemmas. We will specifically examine property and use rights in detail.

##### 3.1.1. Regulation of Property Rights

In contrast to the Pigouvian Tax solution [8] R. Coase [9] assumes that property and use rights must be clearly regulated to enable effective and efficient use and management of resources. In his opinion, it is irrelevant who actually owns these rights as the use which yields most profit will always prevail.

Institutional economics considers property and use rights as key steering factors. The internalisation of external effects can, therefore, be brought about through the (re)definition of property and use rights. Different types of property rights

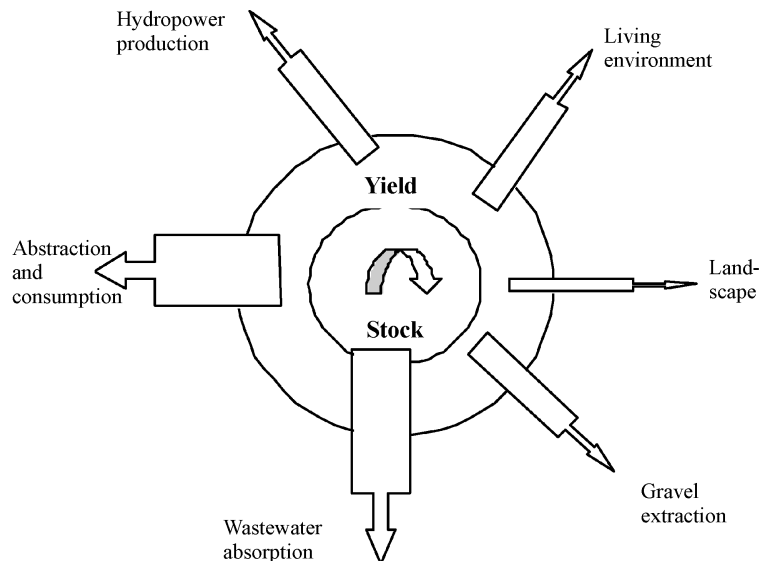


Fig. 1. Water resource and goods and services derived from it.

exist for natural resources. When these property rights have similar characteristics, they are referred to as a property-rights regime.<sup>2</sup> Their classification is based on different criteria [4, 11, 12] which include formal title to property, organisation of exclusion, access control and decision-making processes within the regime. A distinction is made in the economic literature between four classical types of regimes: no property, common property, state property and private property.

In the case of private property, exclusive title to property is in the hands of private individuals or corporations and this must be respected by all others who are interested in the use of this property. The enforcement of the rights is guaranteed by the state. In the case of no property, we have a classical case of resources, for which access is not formally regulated. Common property and open access were thrown together for a long time in the literature and this led to the misleading conclusion that collective ownership in the sense of the “Tragedy of the Commons” [13] would lead to the destruction of the resource. It has now been established, however, that in such cases of collective ownership, the resource in question is controlled and managed by an identifiable group, which establishes rules governing the use of the resource, that avoid the degradation of the resource [4, 14–16].

The institutional economics literature also shows that there is no theoretical or empirical justification for the belief that the private property system per se is better than the other regulative systems.<sup>3</sup> Devlin and Grafton [10] state that there is no “best” regulation and that a mix of regimes can be found in most cases and environmental destruction can be found in all regimes. However, it is possible to identify conditions for the success of specific regulative systems.<sup>4</sup>

### 3.1.2. Limits of the Economic Approach

Institutional economics makes an important contribution to the analysis of resource management in that it draws attention to the function of property rights as steering factors and examines the effect they have on the more or less sustainable use of resources. In our opinion, however, this predominantly static institutional perspective also has its limitations which are indicated below:

- *The consideration of water rights system alone is not sufficient for a comprehensive analysis of resource use and*

<sup>2</sup>Devlin and Grafton [10] have the following to say on this matter: “Often property rights that have a similar set of characteristics are called property-rights regimes. The nature of these regimes is determined by the institutional setting, technology, and the aspect of the environment over which they are held.”

<sup>3</sup>“It should never be assumed that private-property systems are superior to common-property or state-property systems in either an economic, ecological or social sense” [10].

<sup>4</sup>Devlin/Grafton [10] state: “The key to success is to set up an incentive structure for individuals that is compatible with both the characteristics of the resource and institutions.” Thus, there is no sense in introducing private fishing rights in Africa when a collective system already exists.

*management; it must also be analysed in the context of the resource-specific public protection and use policies.*

State regulation of the production and/or consumption of certain goods and services provided by a natural resource is a common occurrence in everyday political life (e.g., residual water regulations for Swiss hydro-electric power plants). In most cases, there are several public policies which regulate the use of a resource and which can result in the degradation of that resource due to their insufficient co-ordination (e.g., water protection and degradation of ground and surface water due to the promotion of intensive agricultural practices). Thus, consideration of the water rights systems alone is not sufficient for the analysis of the institutional framework. In fact, the influence of all relevant public policies on a specific commodity or on the entire resource, and their interaction with the given property and use right arrangement, should be given explicit consideration.

- *The emergence and change of institutional regimes should be the focal issue: A dynamic perspective is required.*

In our opinion, institutions should not merely be understood as given frameworks, within which actions are carried out. Like public protection or use policies, they too are the product and integral components of the political process. Most of the literature concentrates on the analysis of the water rights systems which exist today. Lesser emphasis will, therefore, be placed on the perspective dealing with analysis of the process. In order to avoid further degradation of resources, it is, however, important to know when and under what conditions in the political process the institutional regimes can be changed and how this can be brought about and managed.

- *Specific public policies are becoming increasingly important due to the fact that resource use requirements are becoming more heterogeneous and self-organisation will not suffice as a form of problem resolution.*

Ostrom’s earlier approach [4] focuses on common-pool resources (CPR) and – particularly in the earlier studies on irrigation – is based on the assumption of a homogeneous demand for local commodities and services. In this instance, it was possible to prevent the degradation of resources on the basis of voluntary co-operation, i.e., without state intervention. Although this can be viewed as a very efficient strategy from an economic perspective, this kind of solution is probably uncommon in highly developed societies characterised by increasingly heterogeneous demands and an expanding scope of effects – factors which dictate against a local and regional solution such as common property. Thus, guidance of heterogeneous, growing and increasingly competing use demands is required.

- *Self-organisation was sometimes facilitated by the fact that the negotiations were held in the shadow of hierarchical authority, i.e., rules were backed up by hierarchy.*

In some cases, it is impossible to find any formal traces of state intervention, nevertheless self-organisation was only possible in the shadow of hierarchy [17]. In this context, self-organisation, i.e., the generation of rules, is intertwined with public policy: the spectrum ranges from self-governing rules backed up by the state to an ineffective common-property regime combined with a successful public policy.

- *Actual use regimes are the result of interaction between the ownership structure, state intervention and management practice.*

Empirical examples demonstrate that the actual use regime is not only dictated by the selected ownership structure but results from the combined interaction of the ownership structure, state intervention and management practice. Thus, constancy of structures is not a reliable indicator of the actual management status [18]. Structures can be stable while changes take place in the wider external environment, resulting in a shift in the motivation of the resource users as is the case, for example, in extensive areas of the Swiss Alps.

The above considerations necessitate the development of a wider concept of the IR which will: (1) take into account the influence of exploitation and protection policies, as well as the emergence and transformation of the relevant policy design; (2) incorporate the demands of heterogeneous user groups; (3) consider the influence of management practice as a consequence of individual and group rationality and changed external environment.

### 3.2. Protection and Exploitation Policies

Classical policy analysis has mainly focused on the implementation of state measures (e.g., protection and use policies) and on the evaluation of the resulting effects (e.g., on sustainability of natural resource). In contrast to these empirical studies, little research has been done in the area concerning the actual programme to be implemented (or policy design). No coherent and empirically founded theory has hitherto been developed to explain why a particular aim, instrument or institutional arrangement was selected under a specific policy [19, 20]. Hence, policy design has enriched and transcended public policy analysis.

#### 3.2.1. Design of Water Policies

Here, we understand policy design to be all formal legal regulations, informal co-ordination clauses and institutional structures of a public (protection or use) policy, which policy makers (parliaments, governments) and social actors (competing user groups) deem necessary to regulate the use of a natural resource which is politically perceived as being scarce. A policy design always includes substantial and procedural, material and symbolic dimensions. Here, we suggest that a distinction be made between the five constitutive elements defined below [21, 22].

1. *Aims (or goals)* include the social condition to be aimed at in the area of the collective problem to be resolved (e.g., sustainable use of resources). On the level of legislation, such aims are often formulated in very abstract terms (e.g., “sufficient” biodiversity in the river).
2. *Instruments* comprise the measures to be implemented to achieve the defined aims and the procedural rules for their implementation. They define the intensity of intervention involved in a policy design (e.g., information campaign, financial incentives, regulatory rules and bans) and the procedural form to be taken by the exchange between the relevant administrative authorities and resource user groups (e.g., obligatory consultation of stakeholders, legal right of appeal).
3. *Target groups* are social actors whose behaviour is considered by the protection or use policy as relevant to the resolution of the problem in question. State intervention is intended to transform or stabilise this target-group behaviour in order to achieve the desired aims.
4. *Institutional arrangements* define the authorities and offices responsible for the implementation of instruments. In addition to this area of competence, they are also charged with decisions concerning the public resources (e.g., money, infrastructure, personnel, time, information, consensus) at the disposal of the identified implementing actors.
5. In order to realise the desired effects, each policy design is based on a *policy rationale*, which comprises hypotheses on the effect structure behind the collective problem and the possible forms of state action. The *causal hypothesis* responds to the question as to who or what is to blame or is objectively responsible for the unacceptable use of the resource. This gives rise to the political definition of the target groups. The *intervention hypothesis* responds to the question as to how the behaviour of these target groups can be influenced in such a way as to achieve the defined aims. This gives rise to the political definition of the policy instruments.

Policy analysis shows that such policy designs are often incomplete or incoherent, that they are only partly implemented and/or that the effects achieved only partly correspond to the defined aims. Thus, it is imperative to examine the extent to which the concrete use and management of a natural resource depends on the internal coherence and degree of implementation of such policy designs.

#### 3.2.2. Limits of the Policy Approach

Like the institutional economics approach to resource use and management, policy analysis has also some major shortcomings which are described below:

- *By focusing mainly on policy implementation the traditional policy analysis has an inherent “conservatism bias.” There is a need to question the internal coherence of policy design in order to anticipate foreseeable*

*policy failures and to propose innovative and effective IR.*

As policy analysis mainly focuses on the implementation of existing policies, it is (at least potentially) somewhat conservative. It may try to improve the implementation of existing policies marginally and incrementally with its empirical-analytical conclusions and prescriptive recommendations (e.g., adaptation of an instrument, extension of the implementation arrangement) but it does not really question the policy design and action logic (policy rationale) behind them. The *ex ante* analysis of the coherence of certain policy designs demonstrates, however, that in many cases, implementation deficits and undesired policy effects are or could be completely predictable from the outset. To take this into account, policy analysis should also systematically examine the causal and intervention hypotheses of a public policy.

- “Resource-protection” policies which are normally investigated by the traditional policy analysis concern only one aspect of integrated resource management and sustainability.

Environmental policies are generally conceived to protect a natural resource (or one or more parts thereof). The concept of sustainability is ultimately concerned with taking into account, combining and adjusting both protection and use measures. A comprehensive analysis of the public policies, which together influence the sustainability of a natural resource, should, therefore, also include infrastructure policies in its perspective. At present, the simultaneous and integrated analysis of protection and exploitation policies is either non-existent or extremely exceptional.

- In many cases, sectoral policies are “one use” policies. Such a fragmented perspective is an insufficient basis for comprehensive and integrated resource management.

Environmental policies usually fight the negative effects which arise from a particular use of a resource, of one good or service deriving from a resource (e.g., pollution of water by nitrates). This sectoral approach proves incompatible with the aim of global and integrated resource management (i.e., all goods and services should be considered simultaneously). In addition, the accumulation of several sectoral policies requires extensive co-ordination (intra-policy and inter-policy, vertical and horizontal, etc.) as different sectoral policies are implemented by different specialised administrative authorities and agencies. The transaction costs resulting from this “piling up” of official policies increase with time and can become unsustainable. Similarly, the target groups of these different and numerous public policies sometimes receive incoherent and even contradictory messages and action incentives from the state. Hence, it makes sense from the perspective of state actors and social groups to co-ordinate the policies at the level of the policy design and IR.

- Traditional policy analysis makes no explicit link between public policies and property and use rights. But – as already stated before – the definition of property and use rights is frequently put in concrete form through public policies.

*De facto* (if not *de jure*), public policies distribute specific (even exclusive) use rights to the actors, whose behaviour is to be influenced by the state intervention. Even if the formal property and use rights are no longer being questioned, their material or substantive content is rendered concrete and restricted by public policies. Thus, each policy change involves a redistribution of these use rights. This redistribution explains why it is difficult to alter the *status quo* and identify new winners and losers. Moreover, individual public policies do not take into account the global quota of a resource which is also supposed to satisfy needs which have not yet been discovered or articulated (i.e., goods and services that can be derived from the resource). Hence, an explicit analysis of the relationships between all actors (i.e., also the newcomers), the existing property and use rights that are being redefined by the public policies and the global control and management of the resource is essential.

The above-mentioned limitations suggest the development of an IR concept which will: (1) adopt a resource perspective that is much broader than the sectoral perspective of environmental protection policies that is focused on one or a few goods and services; (2) take into account the logical coherence and practical feasibility of the different policy rationales of exploitation and protection policies; (3) explicitly consider the indirectly or secondary (re)definition of use rights through public policies.

#### 4. INSTITUTIONAL RESOURCE REGIMES (IR): A NEW APPROACH

As suggested previously, the management of resources can be controlled through resource-specific policies and order-policy interventions: the institutional framework in a broader sense is defined in terms of the ownership, disposition and use rights to a resource and the restrictive provisions of special policies for the exploitation and protection of this resource. The central postulate of our new approach assumes that the two steering dimensions are complementary and must be considered both in order to achieve a sustainable resource management. Furthermore, a comprehensive view of the regulations affecting different goods and services is required. We here refer to Institutional Resource Regimes (IR) for the use of natural resources which promote sustainability.

Before presenting the analytical concept (4.1) and the IR typology and development trajectories (4.2 and 4.3), we briefly would like to define what shall be understood by the term institution. Institutions usually are defined as a set of rules which structure the relationship between individuals by

determining the range of possible reactions to certain situations and designing the relationships between individuals in such a way that the – predictable – outcome is equilibrium. Scott [23] states in this context that “Institutions consist of cognitive, normative, regulative structures and activities that provide stability and meaning to social behaviour.” Thus, as a concept “institution” is highly equivocal: institutions can refer to formal rules, behavioural standards, economic and political structures or framework conditions (e.g., [24, 25]). For our purposes, the focus is mainly on the formal rules, i.e., we are interested in their definition, monitoring, implementation, change and evaluation.

Institutions are both the result of former actions and the framework within which their new activities take place. Institutions and, hence, IRs can change over time and become increasingly differentiated. Thus, the definition and classification of IRs shall be carried out from a historical perspective. This requires a combined analysis of the water rights system (legal distribution of ownership, disposition and use rights to the resource) and political factors which are contained in the resource-specific public policies (e.g., protection of minimal water flows, promotion of hydro-power). We work on the assumption that – as stated by Scharpf [26] – the IR embodies a minimum of formal rules in terms of institutional guidance.

**4.1. Analytical Concept**

Resource policy interventions are combined and formed along with (existing or consciously modified) ownership, disposition and use rights in the process of the development of the differentiation of subsystems and public policies. We define an IR as an institutional framework which combines the prominent programme elements of a resource-specific protection and/or exploitation policy (= policy design) with a specific arrangement of the formal ownership, disposition and use rights for the goods and services provided by a natural resource (= water rights system). While in the case of the analysis of the ownership, disposition and use rights it is possible to avail of the classical research on property-rights regimes undertaken in institutional economics, the political factors will be examined with the help of policy (design) analysis. Theoretical and empirical studies shall therefore concentrate on the identification and changes in the central elements of the policy design and of the property and use rights. These constitutive elements are listed in Table 1.

From an empirical point of view, the analysis of the transformation and effects of an IR would imply the identification of the above-mentioned constitutional elements of the IR. The diachronic analysis will allow for making a statement on the extent of the IR and will reveal the goods and services for which the use of the resource was regulated by applying specific public policies, or by means of the introduction of ownership, disposition and

Table 1. The central elements of an Institutional Resource Regime (IR).

Institutional Resource Regime (IR)	
Policy design (PD)	Water rights system (RS)
1. Political aims (according to problem definition)	1. Formal possession of property title (ownership)
2. Instruments	2. Rights of disposition
3. Target groups	3. Specific use rights
4. Institutional (implementation) arrangement	
5. Causal and intervention hypothesis (policy rationale)	

use rights over time. The coherence of the IR can be evaluated by combining the policy design and property and use rights.

In the empirical analysis, a distinction should be drawn between the formal legal nature of state interventions and title to property and the actual incentives set for individual behaviour in relation to the goods and services provided by the resource. Hence, use rights are possibly rendered concrete or new property rights recognised through public policy interventions. Therefore, as a component of public policies, instruments operating on use rights can affect the water rights system. New use rights, such as the access right, may have been introduced, however the formal change may have been the result of the redesigning of the protection and use policy.

**4.2. Typology of Institutional Resource Regimes**

Different stages of the development of an IR development can be identified from a theoretical point of view.

We speak of a “no IR situation,” in cases where neither ownership, disposition and use rights, nor public policies exist. Chances are in this instance that a resource or its services and goods have not yet been discovered. This was the case for biodiversity until recently.

If the use rights are formulated either directly in detailed water rights systems (e.g., new definition and application of ownership, disposition and use rights) and/or at least indirectly through an initial policy design (e.g., general police clause for protection of use rights or bans and licence reservations), this can be referred to as a “simple IR situation.” We suspect that this kind of simple IR emerges when the central actors observe rivalry and scarcity in connection with the predominantly homogenous use of one or several goods or services provided by a given resource and this becomes a collective problem because of the risk of local, regional or global overuse.

In a “complex IR situation,” we can already observe differentiation on the basis of the specific uses of the resource (goods and services provided by the resource) and the combining of the (clarified, redefined) ownership, disposition and use rights with more detailed policy design in terms

of substantive content of the corresponding protection and use policies. The differentiation of the aims of natural resource protection and use policy designs will probably move from negative statements such as “no environmental nuisances” (= general police clause) towards more quantitative, positively formulated prescriptions on the desired quality of the resource (e.g., water quality standards) and, in the next step, in limiting the consumption of specific goods and services in time and space in terms of general quantitative consumption quotas (e.g., minimum water flows). The heterogeneous demands and the sum of the diverse (private-)use rights could lead to a crisis in and possibly even the collapse of the complex IR. Examples of such competing and excessive uses can be found in the area of land (e.g., agriculture, construction zones, roads and railways, etc.), water (e.g., fishing, energy, agriculture, drinking water, etc.) and forest (e.g., biodiversity, recreation, timber, etc.).

One key theoretical and empirical question is whether it is possible to establish an IR which can take account of these varied heterogeneous demands and regulate the totality of threatened uses in such a way that it is possible to maintain the capacity of the whole resource in question for the production of all the goods and services provided by the resource. We refer here to an “*integrated IR situation*” with use of natural resources which promote sustainability. Integrated IRs make it possible to guarantee the transparent satisfaction of the heterogeneous use requirements and to conserve the resource stock.

We suggest a way of integrating the “property rights” and “public policy” paths from the beginning of the analysis. The first dimension for “measuring” this integrative aspect of IR is dictated by the *range of goods and services* (or scope) affected by the water rights system and the policy design aspects. Are all the goods and services derived from the resource affected (to the same degree) by the measures relating to this natural resource? The *actor network* is considered a second important dimension for quantifying the level of integration within IR over a certain period. Here, the judgement with respect to its coherence must be based on the question of coherence between the policy design target groups and the owners, appropriators, and final consumers of specific goods or services derived from the natural resource. Are all owners, appropriators or end-users of a resource defined as target groups in the policy design? Are all users (or appropriators or owners) of a resource affected by the IR (or its changing aspects)? With respect to implementing actors, the question arises as to whether or not administrative structures for implementation exist and to what extent they are equipped with administrative resources. All in all, the question of co-ordination between the different actors appears to be crucial. This means that in order to have a minimum level of coherence, public policies must intervene (via the target groups) in at least one form of property relationship between humans and a resource (i.e.,

Table 2. Typology of Institutional Resource Regime.

Institutional Resource Regime (IR)	Coherence of the actors within the policy network (PD) and the water rights system (RS)		
		High	Low
Range of regulated goods and services (derived from the resource)	High Low	Integrated IR Simple IR	Complex IR No regime

owner, disposition or use rights). This valuation must be applied to each time period. This leads us to the following matrix structure for IR (see Table 2).

### 4.3. Development Trajectories of Institutional Resource Regimes

In our opinion, the historical emergence of an IR and the detection of different stages, as well as their resulting effects on the natural resource, are important topics for future research on resource sustainability. By referring to the concept of a trajectory, patterns of timing and sequence are emphasised and the development path of IRs studied. With this procedure we implicitly assume that the capacity of actors to design optimum institutions (as behaviour incentives) is limited and historically conditioned. Path dependence is by the way used to support the key claim, “that particular courses of action, once introduced, are often virtually difficult or impossible to reverse even if their consequences prove to be disastrous” [27].

From a methodological perspective, the analytical concept of the IR can be defined as both a dependent variable (which factors influence the emergence and change of IRs?) and an independent variable (what are the effects of a particular IR on the users and sustainability of a natural resource?). Hence, two types of hypothesis are required to explain the historical development of IRs and natural resources (as, according to our main postulate, both elements are related). Without making any claim of being comprehensive, the following exemplary hypotheses can be formulated on the genesis and transformation of IRs as well as on the effects of IRs:

1. Existing property rights are hardly ever basically questioned when an IR is changed but redefined on an incremental and resource-specific basis through changes in the policy design.
2. If the intervening protection or use policy is too weak and incapable of producing enough social commodities, the change in IR directly affects the water rights system.
3. The more integrated an IR is, the more sustainable the use of the resource will be, given heterogeneous demand.

To summarise this heuristics, research on the historical IR change aims to examine when, whether, under what

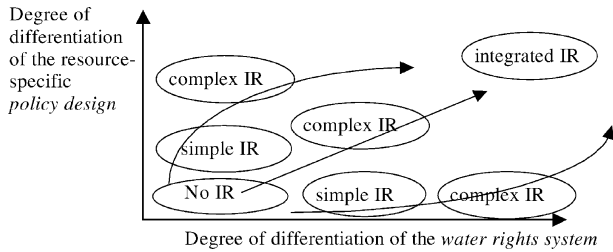


Fig. 2. Development trajectories of Institutional Resource Regimes.

conditions and in what form IRs are established which can regulate all of the use demands and thus react to the growing scarcity of individual goods and services or the destruction of entire stocks of a given resource.

As we previously defined the different types of IR, it is now also possible to identify ideal-typical historical development trajectories. Figure 2 provides an overview of such ideal-typical development paths (NB, the degree of differentiation of policy design and property rights is measured by the range of good and services regulated).

A *Policy-driven trajectory* means that public policies are conceived and implemented in the absence of explicit and clear property rights and their legal definition. It should, however, be noted that the various policy designs can define very well determined use rights (i.e., to a few goods and services provided by the resource), even if only indirectly. However, actual property rights are only clearly formulated and legally distributed among the target groups of the relevant public policies at a later stage.

In the case of a *parallel trajectory*, there is parallel development of the water rights system and the policy design. This means that certain property and use rights are formally defined and distributed while simultaneously setting clear limits with respect to the contents of these rights through different policy designs. The opposite situation is also plausible: if different policy designs are introduced, this provides an opportunity to clearly define and distribute the formal ownership, disposition and use rights which are touched on by the public policies. Hence, it is not necessary to know whether the ownership, disposition and use rights or the policy design are the driving force. It is important, however, that both elements are co-ordinated in terms of both form and content (like identical or Siamese twins).

A *Property-rights-driven trajectory* means that property and use rights are defined and distributed in the absence of the conception and implementation of policy designs. Hence, ownership of a resource or the goods and services it produces are almost absolute and unlimited. With this scenario, policy designs which limit the content of use and property rights or distribute them among various owners, appropriators and final consumers are not developed until a later stage.

It is important to note that exceptions to the three above-described development trajectories may occur. Some *non-linear trajectory* of IRs deviate from the assumed parallelism or clear priority in the historical evolution of the degrees of differentiation between water rights systems and policy designs or from the assumed priority of one element over the other one. Thus, a highly differentiated policy design could become radically simplified if legislation introduces a more sophisticated property and use rights arrangement which is considered as sufficiently guaranteeing a more sustainable use of threatened naturally produced goods and services (e.g., privatisation of previously state-owned resources or the opposite movement towards nationalisation). The same appears even more likely in the case of changing degrees of policy design differentiation in the absence of a corresponding (explicit) change of the water rights system, such as can be observed in the case of many clean air protection policies in some European countries over the past decade (e.g., increasingly differentiated policy designs including more and more polluting substances and ambient air quality standards without visible changes to the attribution of the actual permits among different emitter groups).

## 5. INITIAL EMPIRICAL EVIDENCE: THE CASE OF WATER MANAGEMENT IN SWITZERLAND

As a first attempt to apply the IR concept developed above, the following sections present the historical development of IRs for water management in Switzerland (see [28–30], for a comprehensive presentation of this empirical study).

### 5.1. Institutional Resource Regimes in Switzerland

The examples from Switzerland show a vast spectrum in terms of IR differentiation for different natural resources like water, soil, forest, air and landscape [31, 32]. Analysis of the legislation revealed that in Switzerland, formal ownership, disposition and use rights are often based on federal civil or (additional) cantonal civil or public law, whilst the public protection and use policies can for the most part be formally associated with what is known as the federal or cantonal public law. The Swiss water rights systems have their legal basis *inter alia* in the Swiss Federal Constitution (property guarantee: Article 26) and the Swiss Civil Code (general definition of property: Article 641). Moreover, property restrictions are also increasingly regulated in the special federal public legislation and the corresponding cantonal introduction acts (e.g., environmental protection, construction and regional development legislation, general and special police restrictions of ownership). Finally, there are formal and informal rules and regulations in the sense of common-property, whose significance should not be underestimated and which render the task of classification in terms of different property types extremely difficult.



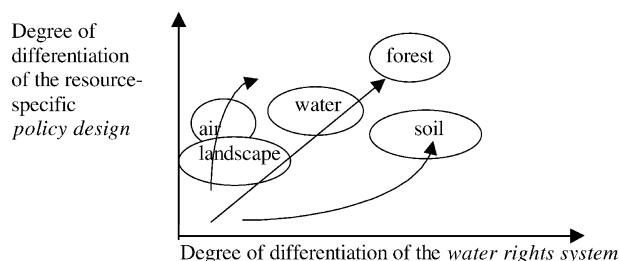


Fig. 3. The gradual differentiation of IRs for five resources in Switzerland.

The following description of IR for water is provided as example of particular combinations of regulative systems and specific protection and use policy designs. Figure 3 shows a graphical presentation of its application to the resources soil, water, forest, air and landscape in Switzerland at the end of the 20th century [33]. Air and landscape regimes follow a policy-driven trajectory and the trajectory of the soil regime can be considered as a property-rights-driven one. Forest and water regimes follow parallel trajectories.

We now discuss more in details the existing IR for the water resource in Switzerland. We shall discuss first the water management conditions related to the Swiss political system, then the goods and services provided by the resource, the development of the property regulation, the policy design development and finally the regime evolution.

## 5.2. Political System and Water Management in Switzerland

The Swiss political system is characterised by direct democracy and by its distinctive federalist structure, involving the federal, cantonal and communal levels. Due to the nature of the Confederation's historical origins, state affairs mostly remained in the hands of the cantons, all of which have their own constitution and political institutions comprising a legislature (generally parliament), government, administration and courts [34]. Over the past century, tasks have been increasingly assigned to the Confederation as a result of the revision of certain articles of the Federal Constitution. Despite this, the Swiss cantons still exercise a great deal of influence and power in the political arena as a result of the "implementation federalism," whereby the implementation of most of the public policies regulated by the Confederation is assigned to the cantons, often with considerable room for manoeuvre. Thus, the administrative structures in the area of water policy reflect the federalist structures of the Swiss political system. The main actors in Swiss water policy are the Confederation, the cantons and the municipalities or local authorities.

Sovereignty over (public) waters is assigned to the cantons. Hence, they are responsible for the allocation of permits, licences, and concessions relating to different water uses such as navigation, fishing and the production of

hydroelectric power. While their activities must respect the framework of the federal legislation, they still have considerable room for manoeuvre. This gives rise to far greater diversity in the administrative structures at cantonal level as compared with the federal administration. The municipalities' responsibilities in the area of water policy mainly involve the operation of sewage systems and wastewater treatment plants as well as the production and distribution of drinking water. As yet, there have been no significant privatisation projects in the areas of water supply and wastewater treatment although the topic is more and more under discussion.

Decision-making processes with respect to water issues take place at state level, to which specific tasks are assigned within the framework of the direct democratic system. A very large number of legislative acts in most policy fields, therefore, are subject to (mandatory or optional) referendum and must be ratified by a majority of the voting population and the cantons. This also applies to water policy issues. As a result of these uniquely Swiss political structures, in general, the non-governmental organisations and traditional "social partners" (e.g., workers unions, economic associations) exert a considerable influence on political decision-making processes.

## 5.3. Goods and Services Derived From the Water Resource in Switzerland

We classify the goods and services provided by the resource water in ten groups [29]. They include a living environment for plants and animals (food and reproduction), drinking water, water used directly or indirectly for the production of economic goods (e.g., irrigation, water-cooling for nuclear plants, drainage, mineral water), hydro-electric power (particular form of water use for the economic production), transport and absorption of waste waters, support for economic production and recreation (e.g., navigation, gravel extraction, fishing), recreation (leisure and tourism), medical uses (e.g., water cures), geomorphologic changes and protection (natural hazards) and strategic reserve (e.g., reserves in case of war or fire). All these goods and services could be theoretically regulated by public policy and/or ownership, disposition and use rights.

Water management in Switzerland currently faces five main challenges: (1) the problem of increasing competition or rival uses of water (in most regions, the spectrum of water uses has become more heterogeneous over the past last decades); (2) the problem of phreatic and lacustrine water quality (related to diffuse pollution); (3) the question of minimal residual water flows; (4) the problem of increasingly impervious soils (waterproofing) in settlements (general water planning at a local-authority scale); (5) the question of natural hazards related to water (floods, permafrost and glacier degradation, debris flows). These five types of problem do not affect the entire country with the

same intensity (e.g., water quality problems in lakes are typical of the rural areas of the Central Plateau; the question of minimal flows or some climatic hazards are more common in the Alpine belt; increasing competition between uses is typical of urbanised and tourist areas, etc.).

#### 5.4. Evolution of the Water Rights System

Before analysing in details the successive phases of IRs development, we first clarify the distinction between private property and public sovereignty, as well as between private and public water bodies (see [35] for a comprehensive legal study of the property and use rights in Switzerland).

##### 5.4.1. Private Property and State Sovereignty

Rights to the ownership, disposition and use of water are regulated by the two general principles of “private property” and “state sovereignty.” The principle of private property is defined in article 667 of the Swiss Civil Code which extends the possession of land to the spaces below and above it (“accession principle”). This includes, subject to legal restrictions, buildings, plants, and springs. The principle of state sovereignty with respect to water restricts private property by reason of the prevailing public interest. This restriction does not involve a formal transfer of the ownership title, but it complies with the assignment of a matter to the public domain and, therefore, withdraws such objects from private influence without changing any existing property title.

In general, use rights to a resource under state sovereignty are assigned by means of permits (e.g., for sailing events on lakes), licences (e.g., for fishing) or concessions (e.g., for hydroelectric power production), which offer a use right to a specific resource for payment of a fee.<sup>5</sup> In all of these cases, the state retains sovereignty with respect to the resource while according use rights to (e.g., private) users. Generally, concessions and permits are assigned by the cantons, municipalities and, in some cases, public bodies.

##### 5.4.2. Private and Public Water Bodies

The Swiss Civil Code (CC), which dates from 1912, makes a distinction between public water bodies (article 664 CC) and private water bodies (article 704 CC), on the basis of specific characteristics. The first category – public water bodies – includes surface waters (rivers, streams and lakes) as well as glaciers and névés. Flowing water should be considered as *res communes omnium*. As such, they are subject to state sovereignty, which means that the state can regulate their use rights. The cantons are responsible for this regulation (article 664, al. 3 CC and article 24 bis, al. 3 Cst). A landowner does not, therefore, own the surface water that flows along his/her

property. Thus, the surface waters in all cantons are considered public property with the sole exception of the canton of Glarus where surface waters are considered private property.

Groundwater springs are considered private waters (article 704 CC). They represent an integral part of the ground on or under which they are located (article 667 CC). The landowner can, therefore, dispose freely of springs and groundwater. However, the Swiss Civil Code does impose limitations on the disposition right, particularly with respect to the supply of water to neighbours (articles 709–710 CC) and in the general public interest (article 705 and 711 CC). Springs rising from a glacier or terrain unsuited to cultivation (rocks, boulders etc.) (article 664, al. 2 CC), some major springs of general interest and springs at the head of a river or stream are all considered as public property. Similarly, even if they are formally comparable to water springs, expanses of groundwater of a certain size have gradually come to be defined as public water.

##### 5.4.3. Historical Evolution of the Water Rights System

The evolution of the water rights system relating to water has been divided into three main phases (see Table 3 below). The *first* phase (1874–1912) is primarily characterised by the Confederation’s initial intervention affecting property rights to water (private or public, cantonal or local) in the area of the “protection against water” and, later, its use for hydroelectric power production. The sovereignty of the central state over dams on mountain watercourses was enshrined in the constitution with the adoption in 1874 of *article 24* which instituted the “high superintendence” of the Confederation over the regulation of dams in the mountain regions. The Federal Law on the Regulation of Waters in Elevated Regions of 22 June 1877 was adopted three years later. On the basis of this law, the Confederation was to exercise “*high superintendence over the regulation of waters in elevated regions of Switzerland*” (article 1). Article 8 makes provision for the *expropriation* which may be necessary to implement this law and which would result in the modification of property rights to water, both private and public, in the public interest.

The *second* phase (1912–1953) is marked, on the one hand, by the adoption of the Swiss Civil Code in 1912, which defines private and public water on a national level and represents a major change within the regulative system, and, on the other hand, by a series of interventions affecting disposition and use rights of water which aimed at restricting unlimited private property rights for the sake of the public interest. The Civil Code defines that the rights of disposition of public water is regulated by the cantons (article 664, al. 3 CC), particularly with respect to the granting of licences, permits and concessions. With the coming into force of the Federal Law on Water Power of 1916, these rights of disposition were subject to a clearer formal regulation (Chap. 3 of the law about the concessions). Article 17

<sup>5</sup>Concessions differ from licences in that with licences, users obtain the right to use the resource in competition with users of the same type (e.g., other fishermen or sailors) whereas in the case of concessions, the user receives an exclusive right to the use of the resource.

Table 3. Phasing of the water rights system between 1874 and 2000 (Legend: X–XXX indicate on the relative importance of the respective dimension in a certain period).

Phases	Interventions on			Range of goods and services regulated	Main actors groups
	Ownership rights	Disposition rights	Use rights		
Phase 1: 1874–1912	XX			Geomorphological changes, hydro-electrical power, and production (floating, irrigation)	<b>State:</b> Federal State, Cantons <b>Owners:</b> Municipalities and cantons, private owners <b>Appropriators:</b> Traditional appropriators (irrigation unions, floating companies, traditional industry), spatial planners (administrations of the Confederation and the cantons), hydroelectricity companies <b>End-users:</b> Riparian residents (mainly in the lower valleys and in the Central Plateau), industry (metal), industrial services of certain cities in the Central Plateau
Phase 2: 1912–1953	XXX	XX	X	Consumption, production, energy, support, recreation, medical uses, geomorphological changes, and strategic reserve	<b>State:</b> Federal State, Cantons, Federal Court <b>Owners:</b> Municipalities and cantons, private owners <b>Appropriators:</b> Idem 1874–1912 + other companies making use of concessions (e.g., for gravel extraction), distribution services of cities in the Central Plateau <b>End-users:</b> Riparian residents, industry, electricity distribution services of cities, consumers (drinking water and electrical power)
Phase 3a: 1953–1975			XX	Living environment, consumption, production (industry), and absorption	<b>State:</b> Federal State, Cantons, Federal Court <b>Owners:</b> Municipalities, Cantons <b>Appropriators:</b> Mainly public corporations (water distribution and wastewater removal services) <b>End-users:</b> Households, industry, fishers, aquatic fauna and flora
Phase 3b: 1975–2000			XX	Living environment, consumption, production (industry and agriculture), energy, absorption, support (gravel), geomorphological changes, and strategic reserve	<b>State:</b> Federal State, Cantons, Federal Court <b>Owners:</b> Municipalities, Cantons, private owners <b>Appropriators:</b> All pot. appropriators, esp. hydroel. comp. and terr. planners (restrictions regarding to the management of watercourses) <b>End-users:</b> Households, industry, riparian residents, fishers, aquatic fauna and flora, tourists

introduced into law the principle of the subordination of the use of private watercourses to the cantons (limitation of the right of disposition over private watercourses). According to the Civil Code, the right of disposal over *private water bodies* is, in principle, unlimited. Limitations exist, however, in favour of neighbours (articles 709 and 710 CC) and in the case of the prevailing public interest (articles 705 and 711 CC). This right of disposition was also diminished with the coming into force of the Civil Code, which instigated the actual transfer of certain private water bodies to the public sphere. With respect to *use rights*, the only rights strongly affected during this period were use rights for hydroelectric production.

During the *third* phase (1953–1975), ownership and disposition rights as defined in articles 664, 667 and 704 of the Civil Code did not evolve formally. The only change in the water rights system was on the level of the organisation of use rights. The main changes were brought about by the adoption of article 24 quater of the Constitution (1953) on the protection of water bodies against pollution, which introduced a major new restriction on users of the resource water: all uses, irrespective of their nature, must preserve the quality of water bodies. The revision of article 24 bis of the Constitution in 1975 added new restrictions to the use of water, particularly with respect to hydroelectric power, by instituting the principle of the quantitative protection of the

hydro-system. The sub-division of this phase into two sub-phases is therefore based on the two different types of intervention which emerged: the protection of water in terms of quality in phase 3a (1953–1975), and in terms of quantity in phase 3b (1975–2000).

In general terms, we can observe a gradual shift over the 20th century from interventions affecting ownership rights (phases 1 and 2) to interventions affecting disposition rights (phase 2) and use rights (phases 3a and 3b).

**5.5. Evolution of the Policy Design Relating to Water**

Significant developments were observed with respect to public policies and these took place in four main phases. Swiss water-related policies have mainly developed along three main topics: protection against water, water exploitation (for hydroelectric power production), and protection of water. The relative importance of each of these topics within the different phases of the Swiss water policy is evidenced according to the ten groups of goods and services derived from the resource water (see Table 4 below). A shift in the

relative importance of specific goods and services in a certain phase indicate the problems and their perception for the reference period (e.g., for “consumption” and “absorption”: shift from “exploitation” to “protection” at the end of the century). Actually, all goods and services can be assigned to new topics in a new phase.

Two main collective problems were to be solved during the *first* phase (1871–1908): on the one hand, an increase in *flood events* which marked the whole 19th century and the cause of which was assigned to deforestation in mountain areas; on the other hand, *pollution* of certain stretches of rivers beneath cities and industrial plants (mainly Basle) which threatened fishing activities. Policies regulating *protection against water* (river corrections, alluvial valleys drainage, mountain torrent corrections) were created at the turn of the century. The major river correction projects of the 19th and 20th centuries were mainly concerned with the protection of people, the land and other goods. Hydraulic engineering structures were mainly intended to provide protection against mountain torrents, erosion and landslides and this was the motivation behind the combination of

Table 4. Phasing of the public policies related to water between 1871 and 2000.

Phases	Description	Range of goods and services regulated	Main actors
Phase 1: 1871–1908	Policy relating to the protection of the population <i>against water</i> (floods) and first signs of intervention relating to the quality of water	Geomorphological changes, living environment, fishing, and absorption	<b>Actors of the institutional arrangement:</b> Confederation, federal administration on forests <b>Target groups:</b> Municipalities (in mountainous regions), forest owners, polluting industry <b>Pressure groups:</b> Scientists, experts (forests) <b>End-users:</b> Population in the plains, fishers
Phase 2: 1908–1953	Policies relating to the <i>exploitation</i> of water, mainly valuation of its potential for hydroelectric production and for agriculture (drainage)	Hydroelectricity, drainage, geomorphological changes, living environment, fishing, navigation, and absorption of wastewaters	<b>Actors of the institutional arrangement:</b> Confederation (federal administrations on forests, of energy, and military), administrations of the cantons (forests, energy), municipalities in mountainous regions <b>Target groups:</b> Farmers (drainage), owners of watercourses, polluting industry <b>Pressure groups:</b> “Heimatschutz”, environmentalists, municipalities in mountainous regions, experts (water pollution) <b>End-users:</b> Farmers, population, Swiss economy
Phase 3: 1953–1991	Policies focusing on the <i>qualitative protection</i> of surface and groundwater	Consumption, bathing, energy, irrigation, drainage navigation, fishing, geomorphological changes, living environment, and absorption of wastewaters	<b>Actors of the institutional arrangement:</b> Confederation, cantons, federal and cantonal administrations (mainly services for the protection of water), international commissions <b>Target groups:</b> Municipalities, industry, farmers <b>Pressure groups:</b> Associations for water protection, environmental organisations <b>End-users:</b> Overall population, aquatic fauna and flora, fishers
Phase 4: 1991–2000	Policies aiming at a <i>global protection</i> of water in terms of quality and quantity in order to preserve the supply of drinking water, the functioning of the hydro-system, and, more generally speaking, the environment	Consumption, landscape conservation, energy, agriculture, navigation, gravel extraction, fishing, geomorphological changes, living environment, and absorption of wastewaters	<b>Actors of the institutional arrangement:</b> Confederation, cantons, federal and cantonal administrations (mainly services for the protection of the environment) <b>Target groups:</b> Municipalities, hydroelectric companies, farmers, army <b>Pressure groups:</b> Environmental protection organisations, “anti-ecologist” groups <b>End-users:</b> Overall population, aquatic fauna and flora, fishers

hydraulic engineering and forest regulation concerns in the mountain regions (Article 24 of the Swiss Federal Constitution of 1874, Federal Law on the Hydraulic Engineering Police of 1877). The target groups of the federal measures were mainly the owners and users of forests, the local municipalities (owners of forests) in mountainous regions and polluting industrial companies.

*Water use* policies (particularly concerning energy production) increased during the *second* phase (1908–1953). The use of water for the production of hydroelectric power resulted in the awarding of concessions (Article 24bis of the Federal Swiss Constitution of 1908, Federal Law on the Use of Water Power of 1916). The damming proposals of the first period were joined by measures aimed at promoting the drainage of uncultivated land, initially during the Second World War in the context of the “Wahlen Plan,” and then mainly in the context of measures to improve land use associated with the coming into force of the Agriculture Law of 3 October 1951. This law resulted in the implementation of a major programme of land improvements aimed at increasing agricultural productivity. The target groups during this phase were the farmers (drainage), the owners of watercourses (production of energy) and the polluting industries.

The *third* phase (1953–1991) saw the development of *water quality protection* policies (Article 24 quater on protection of water of 1953, Water protection laws of 1955 and 1971, Law on the Protection of the Environment in 1983, Decree on Substances and Interdiction of Phosphates in Detergents in 1986). Increasing population density, industrialisation and economic expansion meant that water suddenly needed protection because of great problems of water quality (mainly eutrophication of lakes). Article 24 bis of the Federal Swiss Constitution was redefined in 1975, with the aim to improve the co-ordination of all efforts and to take into account the entire water cycle in the protection policy: household use, protection of water springs and prevention of damaging effects to water (qualitative and quantitative protection). However, this global approach was only really implemented with the adoption of the third Law on Water Protection in 1991. The target groups of the water protection policies were mainly the industries and the local municipalities (responsible for the development of wastewater treatment plants). Farmers affecting water by diffuse pollution and users transforming the hydrological processes, such as hydro-electrical companies, were not targeted by the water policies.

During the *fourth* phase (1991–2000), the qualitative and quantitative water protection acts were included in 1991 in the revision of the water protection acts of 1971 (introduction of regulations on residual water flows in addition to the existing care and redevelopment obligations, sewage treatment plants, limit values for toxic substances etc.). In 1991, the old law on the regulation of waters was also revised (Federal Law on the Management of Watercourses) in order to take into account the new needs of protection of the

hydrological processes. In 1996, the Water Power Act of 1916 was also revised and introduced disposition for the protection of landscape (new Article 49). Finally, the Decree on the Protection of Water of 1998 formulated ecological aims for water bodies and made provisions for the implementation of planning instruments (e.g., water protection areas, water protection measures, ground water protection areas for drinking and service water) as well as specific measures (e.g., fertiliser use that is compatible with protection of water). During this phase, nearly all the goods and services provided by the water resource are considered. The target groups are therefore wider and include the local municipalities, the industries, the farmers and the army.

The main impact of this evolution has been a redistribution of the relationships between the various goods and services produced by the resource water (e.g., water policy at the beginning of the century did not recognise the service of water as a living environment for plants and animals; the preservation of this service is one of the main objectives of the current Federal Law for Water Protection adopted in 1991).

However, there is no integrated water policy (i.e., one that integrates all the goods and services produced by water) in Switzerland and the problem of the impact of the recent changes in the water policy on sustainability is still an open question. In the next chapter, we shall combine both approaches (evolution of the water rights system and the public policies) to evidence the development trajectory of the water regime.

## 5.6. Development Trajectory of the Water Regimes in Switzerland

Throughout the reference period (1870–2000), it is possible to distinguish five phases in the development of the water policy regimes development in Switzerland (see Table 5 below).

The *first* phase (1870–1912) is qualified as a *simple* regime due to the fact that on the national level there did not yet exist a unified water rights system. It was only in 1912 that the property rights to water were clearly regulated at national level with the enactment of the Swiss Civil Code. The situation cannot, however, be qualified as “no regime” as from 1870s, the sovereignty of the federal state over two water issues, i.e., the policing of dams (after 1874) and the exploitation of hydroelectric power (after 1908) were gradually introduced in Switzerland. This must actually be considered as a strong restriction of the ownership and disposition rights of the owners of surface waters (often the cantons or local authorities). On the other hand, public policies were characterised by a low level of diversification, which again justifies the classification of this phase as a simple regime. There was no competition between the different groups of goods and services concerned which, moreover, were weak in scope. The coherence of the regime was medium: with regard to protection against water, the target groups partly coincided with the owners of the surface waters (public bodies); in the field of water protection, the

Table 5. Phasing model for the evolution of the institutional water regimes in Switzerland (1870–2000).

Phases	Water rights system (RS)	Policy design (PD)	Institutional regime
Phase 1: 1870–1912	No unified water rights system at national level; ownership rights are regulated at cantonal level (mainly private property) Establishment of the sovereignty of the federal state over the policing of waters and the utilisation of hydropower	Emergence of independent sectoral public policies with three particular objectives: protection against floods, decrease of pollution in urban zones, improvement of electricity supply in the country	<i>Simple regime</i> Weak scope (mainly for the RS) Weak external coherence
Phase 2: 1912–1953	Introduction of the Swiss Civil Code (1912): distinction between public (surface waters) and private waters (underground water and springs) The Civil Code does not regulate any specific goods and services General establishment of the concession system for the utilisation of water for hydroelectric power production	Implementation of three independent sectoral public policies (protection against water, exploitation of water, water protection) aiming at regulating several collective problems (protection of the population, protection of the environment, production of goods and services, energy, and food)	<i>Simple regime</i> Weak scope (increasing for the PD, but remaining weak for the RS) Medium external coherence (some target-groups are not the owners)
Phase 3: 1953–1975	Limitation of certain use rights (discharge of wastewater, households) through measures for the protection of water in terms of quality	Intensification of the implementation of independent sectoral public policies (mainly in the field of water protection) aimed mainly at solving the qualitative problems of water (eutrophication). Diffuse pollution by agriculture is not regulated	<i>Complex regime</i> Medium scope (quantitative uses not regulated) Medium external coherence
Phase 4: 1975–1991	Limitation of use rights through measures for both the qualitative and quantitative protection of water and through environmental protection measures	Intensification of the qualitative protection of water (2nd Law on the Protection of Water, 1971); adoption of the “polluter-pays” principle (Law on the Protection of the Environment, 1983) and of planning and co-ordination measures.	<i>Complex regime</i> High scope (quantitative uses regulated in the RS from then on) Medium external coherence
Phase 5: 1991–2000	Increase in the restriction of disposition and use rights in the third Law on the Protection of Water (1991)	Integration of the sectoral policies into the framework of the third Law on the Protection of Water (1991)	Transition <i>towards an integrated regime</i> High scope High external coherence

target groups (polluting industries) were not the owners of the resource.

The subsequent phase (1912–1953) is also qualified as a simple regime due to the fact that, despite the enactment of the Civil Code in 1912, the scope of the goods and service regulated remained low. In fact, the Civil Code regulated the ownership and disposition rights to private and public waters but it did not explicitly concern specific goods and services. In other words: the Civil Code regulated the ownership but not the use rights. However, it must be stressed that this major change in the water rights part of the water regime was more promoted by a general political evolution in Switzerland (evolution of the Confederation) than by a need that specifically arose from water management itself. Furthermore, with the establishment of a third branch of water policy (exploitation of hydroelectric power), the coordination of the different policies showed a tendency to decrease. The lack of co-ordination between the three branches of water policy then increased further during almost all of the

20th century. The external coherence remained weak due to the same reasons as in the previous phase.

After 1953, the regime can be qualified as *complex*. Firstly, the water rights system was beginning to change through the introduction of restrictions on use rights aimed at the qualitative protection of water, a phenomenon which did not exist before the adoption of Article 24 quater of the Constitution in 1953. Secondly, the scope of the regime and the competition between uses increased. The pressure for further restrictions of use rights in order to promote protective activities mainly came from the local authorities and industry (i.e., target groups) which supported the aim of reinforcing water protection with the help of further subsidies for the construction of waste water treatment plants. They acted through their representatives in parliament and also by means of a popular initiative. The external coherence of the regime remained medium: certain target groups (e.g., farmers for drainage, polluting industries) did not possess ownership or disposition rights to water. Efforts to establish co-ordination

between the actors in the three branches of water policy were more or less non-existent during this period.

The regime was *complex* throughout the subsequent 15 years (1975–1991). We separate it from the previous phases mainly due to the adoption of the Article 24bis of the Constitution in 1975. This article translated the growing awareness since the 1970s of the necessity to integrate the qualitative and quantitative management of water into a concrete legal basis. However, this increasing awareness, which was repeatedly expressed by the population, would take more than 15 years to be put into concrete terms with the adoption of the new Law on the Protection of Water of 1991. In the course of this 15-year period, the political terrain was gradually prepared through various political decisions in the field of environmental protection (e.g., Law on the Protection of the Environment of 1983, Law on Land-Use Planning of 1979). The *scope* of the regime became rather high: basically all goods and services were regulated. Compared to the previous phase, the policy design improved to some extent; this was mainly a consequence of the development of co-ordination instruments between the different sectoral water policies (e.g., zoning, wastewater discharge plans, the balancing of different interests). The external coherence is qualified as medium due to the fact that the target groups were far more restricted than the actors who were actually concerned by the water rights system. This gap was generated by the absence of political regulations on quantitative use rights to water.

By considering actors who draw large quantities of water for their uses (e.g., irrigation, hydroelectric power generation) as target groups of water policy in Switzerland, the new Federal Law on the Protection of Water in 1991, however, bridged this gap. We can, therefore, qualify the regime as one with a high external coherence. But the policy design itself is still characterized by the absence of good co-ordination between the three former sectoral water policies and by a weak level of concretisation – at least at that time – of the principle of quantitative water protection. As all of the goods and services of the resource water were now regulated, the regime has a high *scope*. We can, however, consider the present water regime an *integrated regime*.

In conclusion, we may state that at national level, the water regime developed from a simple regime (1870–1953) to a complex regime (1953–1991) before achieving the start of integration in the 1990s due to the adoption the third law on water protection.

## 6. CONCLUSION: USEFULNESS AND LIMITATIONS OF THE IR APPROACH

The advantages and added value of the IR approach can be summarised in seven points.

- (1) The IR approach proposed in this article shed new light on the study of heterogeneous uses instead of (single) homogeneous use. One limitation of the Common Pool Resource (CPR) theory is that it focuses on a single use (see, for example, the criticism of Steins and Edwards [36]). An approach based on the multiple-use IR is much more realistic in countries with a high heterogeneity of water uses, like industrialised countries. It also stresses the re-distributive effects of IR change between different user groups (i.e., social dimension of sustainability).
- (2) The resource perspective (stock and yield) also allows consideration of all the goods and services provided by a resource, including those goods and services that have yet to be discovered. This facilitates a parallel consideration of protection and exploitation policies (i.e., economic and environmental dimensions of sustainability).
- (3) The integration of resource policies and order-policy intervention makes it possible to draw a distinction between formal property rights (private law) and informal but real use rights (public law, self-regulation). The gain in insight associated with this combined concept can be demonstrated as follows (see Fig. 3, Section 5.1): for example, if one examines the property and use rights alone, the regulative system for the resource soil emerges as being “better” (related to the horizontal axis) than that for the resource water. If the policy design is examined in isolation, the policy design for the resource water emerges as being “better” (related to the vertical axis) than the soil policy design. These contradictory conclusions are merely partial and can be overcome if the two dimensions of each IR are considered in conjunction.
- (4) With respect to practical utility, the combining of public policies and property rights gives rise to an enlargement or broadening of the steering potential of natural resources. As a result, it helps us to conceive new directions for the sustainable steering of natural resources (comprehensive and integrated management for resources). The comparison of the regimes reveals possibilities as to how control, and hence the institutional framework of the resource management, can be improved. Whereas, for example in the case of soil, co-ordination between the different policy areas would represent an urgent priority, in the case of air and landscape, the creation of property rights would be an option. The proposals must be conceived in such a way as to allow new possibilities for sustainable use in the form of incremental development. Property rights changes can only be provided if windows of opportunity are available.
- (5) Insights into the status and the conditions of the formation of IRs also allow the consideration of the external factors of the Common Pool Resources (CPR). Whereas many studies on CPRs describe the design principles of the management system itself, the external ecological, socio-economic and – in particular – the political-institutional context are neglected. Furthermore, the IR concept considers the frame set by sectoral policies as important for the use of resources.

- (6) The identification of triggers of IR change will facilitate improved treatment of rival uses of public and mixed goods. This should provide further insights into where, when and on the basis of which political conditions the resource regimes change under the influence of politically perceived scarcity.
- (7) The example of water in Switzerland shows that the proposed regime analysis can be applied with success to the study of the evolution of resource use and protection in industrialised countries. As already stated, taking into account only one dimension of the IR concept (design or property rights) would give only partial results. The regime concept should however been tested in other situations like urban areas in developing countries. Moreover, the analytical framework would certainly give good results in the analysis of situations with high natural or human-created scarcity, and therefore high competition between uses (e.g., desert environments, overpopulated mountain regions, etc.).

The proposed IR-framework has also some evident limitations and weaknesses:

- (1) The analysis of the water rights system and the policy design was made at the national level. In federalist countries, like Switzerland, regional (here the Cantons) laws are very diversified. It is therefore difficult to evidence a “national IR.”
- (2) The regime analysis does not take into account informal rules, like negotiations between actors, oral traditional regulations, social norms, and even illegal practices, that can highly modify the formal IR.
- (3) The scale in which the practices of various user groups has the highest impacts on the sustainability of water management is certainly the regional scale (e.g., river) and not the national level. In order to analyse the impacts of an IR on the resource sustainability, a change of scale is needed. It is not sure that there is not a real gap between the national regime and the practices at a local or regional level (river basin or tributary basin).

Thus, comparative case studies at a river basin scale are requested in order to evidence the links or potential gaps between the national regime, as shortly described in this article,<sup>6</sup> and the real local or regional practices in different river basins of Switzerland. Such case studies should allow to identify formal and informal rules-in-use and to assess the possibilities of testing the effects of a specific IR on the resource sustainability, using indicators of economic, environmental and social development.

<sup>6</sup>Our diachronic analysis could be made much richer through more detailed presentation of the institutional design process itself. The identification of the social groups who support or oppose the various institutional developments and the mapping of the change of their interests over time are partly discussed in [30]. Bakker et al. [2001] provide a theoretical and methodological framework for such an institutional-stakedholder analysis.

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