Malgré des succès tout à fait significatifs remportés par les politiques environnementales depuis un demi-siècle, force est de constater que ces dernières ne suffisent pas en l'état actuel, à garantir un usage véritablement durable des ressources naturelles. Tout semble en effet se passer comme si ces différentes politiques publiques de protection de l'environnement - fondées essentiellement sur des objectifs et des instruments de limitation des émissions nocives pour le "voisinage" - avaient trouvé aujourd'hui leurs limites.
Fort de ce constat, fondé sur des analyses empiriques approfondies de processus d'exploitation de ressources, ainsi que sur une analyse systématique des règles régissant leurs usages et les droits des usagers, ce cahier propose une nouvelle lecture du monde empirique à l'aide du concept de "régime institutionnel de ressources naturelles" (RIRN). Adoptant une approche véritablement ressourcielle et combinant les apports analytiques de l'analyse des politiques publiques avec la théorie des droits de propriété développée par l'économie institutionnelle des ressources, le concept de régime institutionnel fournit des instruments d'analyse plus appropriés pour comprendre les enjeux de régulations des ressources naturelles dans les pays industrialisés et partant, permet d'identifier les principaux obstacles actuels à une gestion durable de ces ressources. Ce faisant, il permet également de formuler quelques principes normatifs et de recommandations quant à la manière de concevoir des dispositifs de régulations susceptibles de garantir une gestion durable des ressources naturelles dans nos sociétés. Finalement, les auteurs présentent en conclusion quelques pistes concernant l'application du concept de régime institutionnel à d'autres types de ressources matérielles, artificielles, culturelles ou encore symboliques.

Despite considerable successes that have emerged from environmental policies over the last half-century of atmospheric pollution, the latter are not sufficient in their current state to guarantee a truly sustainable use of natural resources. In fact, it appears as though these various environmental protection policies - basically on objectives and instruments designed to limit noxious emissions in neighbouring areas - have now found their limits.
Based on in-depth empirical analyses of resource exploitation processes and a systematic analysis of the rules that govern resource uses and the rights of resource users, this contribution presents a new interpretation of the empirical world by employing the concept of "institutional natural resource regimes" (INRR). This resource-based approach combines the analytical strengths of public policy analysis with the theories of property rights of institutional resource economics, and thus it is an appropriate analytical framework for understanding the issues of natural resource use regulations in industrial countries and identifying the obstacles that hinder sustainable resource management. Furthermore, it is a framework from which to formulate normative concepts and recommendations regarding the way in which to design the regulations most likely to guarantee a sustainable management of natural resources. Finally, the authors present some thoughts concerning the application of the concept of institutional regimes to other types of material, intangible, cultural, and symbolic resources.

The Sustainable Management of Natural Resources

Peter Knoepfel
Stéphane Nahrath

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idheap

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From Traditional Environmental Protection Policies towards Institutional Natural Resource Regimes (INRR)

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Institut de hautes études en administration publique
Swiss Graduate School of Public Administration
Institut universitaire autonome
Route de la Maladière 21 CH-1022 – Chavannes-Lausanne
T : +41(0)21 557 40 00 – F : +41(0)21 557 40 09
idheap@idheap.unil.ch – www.idheap.ch

Table of Content

Introduction		**1**
1	**The Management of Natural Resources on the Basis of Traditional Environmental Policies**	**3**
2	**The Genesis and Development of the Political and Institutional Regulation for the Use of Natural Resources**	**9**
2.1	Basic concepts	9
2.2	Origins of the need for regulation of the uses (G&S) of a resource: the contribution of institutional resource economics	17
2.3	The basic elements of the institutional regime	22
3	**Institutional Natural Resource Regimes (INRR): Theoretical Bases**	**27**
4	**The Concept of Institutional Natural Resource Regimes (INRR)**	**35**
4.1	Policies and property rights	35
4.2	The concepts of regime coherence and extent	46
4.3	Typology of regimes and their repercussions for sustainable development	50
5	**Empirical Applications**	**55**
5.1	Applications of the INRR concept to the analysis of the empirical regulation of situations involving the exploitation of natural resources	55
5.2	The normative use of the concept of institutional regimes as a platform for the development of (new) institutional regulations aimed at the more sustainable management of natural resources	59
6	**By way of conclusion …**	**63**
7	**Bibliography**	**65**

Introduction[1]

There are few terms that are used in such an inflated manner as the word "sustainability". Politicians, businesspeople, scientists and all kinds of advertisers consider themselves, their proposals, their articles and their beliefs to be more sustainable than the ones of their competitors. Listening to them, one gets the impression that our world is the most sustainable one imaginable. Looking at reality, the exact opposite is true. Globalization accelerates all kinds of industrial, domestic and urban metabolisms and increasingly unbundled market mechanisms are becoming a serious threat for the survival of the reproductive capacities of our common natural resources. With the advancement of globalization and market liberalization, the need for solid institutional mechanisms capable of guaranteeing the survival of normally local and/or regional natural resources has tremendously increased in the last twenty years. Traditional environmental protection policies are incapable of doing this job. Like many other scholars and politicians, we believe that fundamental changes in the way we manage our common natural resources are inevitable if we claim to fight against the "plundering of our common wealth" [Bollier 2002].

This article is meant to be a modest contribution to the theoretical and empirical thoughts towards a solution of this vital problem of overexploitation of natural resources. It firstly explores the traditional response to this question which consists of a wide range of environmental policies, each of which has the objective of providing a solution to the collective problem of protecting the resource against pollution. Taking into account the current situation, which shows increasingly clear indications of a lack of sustainability in the exploitation of these resources, we then undertake to demonstrate that these traditional processes use

[1] We acknowledge Lee Nicol for rereading the final version of this text. The original French version can be found in Knoepfel and Nahrath [2005 : 199-255]. We are grateful to the the publisher of the original version (Presses Polytechniques et Universitaires Romandes in Lausanne, Switzerland) for authorizing the publication of this translation.

highly diverse policies – essentially based on the objectives and instruments of emissions restrictions – and have reached their limits (section 1). With the help of more detailed observations of empirical processes involving the exploitation of natural resources and of the rules that currently regulate their uses and the rights of users (section 2), we present a new reading of the empirical world based on the concept of institutional natural resource regimes (INRR), a concept that takes into account the property, disposal and use rights of actors who use these resources along with the policies that govern them (section 3). In our view, the analytical capacity of this new concept is superior to that of both policy analysis and institutional resource economics. This belief is backed by a number of empirical research projects carried out by our team since 1998.[2] This chapter presents the INRR concept and its main theoretical bases while also adding some relatively new dimensions to the issues surrounding its empirical and practical application (section 4) which have not yet been published elsewhere.[3] The concluding section (section 5) presents some suggestions concerning the application of the INRR concept to other types of resources besides natural ones.

[2] This group, which met frequently in the course of numerous working sessions, includes, in addition to the two authors, David Aubin, Kurt Bisang, Jean-David Gerber, Ingrid Kissling-Näf, Corine Mauch, Emmanuel Reynard, Raimund Rodewald, Jérôme Savary, Adèle Thorens and Frédéric Varone. The research carried out by the group was financed through three FNS (Swiss National Science Foundation) projects (Division I and Division IV) and by the Swiss Federal Office for Education and Science. The following researchers also participated in the development of this analytical framework in the context of the European "Euwareness" project (EVK1CT-99-0038): Hans Bressers and Stefan Kuks, Corinne Larrue, Bruno Dente, Joan Subirats, Frédéric Varone and their colleagues. Numerous students from the IDHEAP and the Postgraduate Diploma (DESS) in Urban Studies of the University of Lausanne also contributed by means of studies (seminar papers and diploma theses) involving the application of this concept.

[3] Other presentations of the analytical framework of INRR can be found in Kissling-Naef and Varone [2000a], [2000b]; Knoepfel, Kissling-Naef and Varone [2001:11-48], [2003: 1-58]; Nahrath [2003a: 5-55].

1 The Management of Natural Resources on the Basis of Traditional Environmental Policies

Anyone proposing to manage natural resources in a way that is compatible with the environment, or to use the language adopted in the aftermath of the Rio Earth Summit in 1992 "sustainably", will refer to the enormous body of environmental protection legislation that exists in Switzerland, in all European countries and on the level of the European Union. The aim of this legislation is to protect human beings, plants and their bicenonsis against hazardous or noxious substances by reducing them to a level that can be considered tolerable. These policies are conceived as a means of fighting immissions[4] (i.e. environmental impacts) through the imposition of reductions in emissions. While it cannot be denied that such policies have produced results, in particular with respect to the protection of water bodies, the protection of the air and the treatment of waste [Varone 2004], they have been clearly less successful in the area of the (qualitative and quantitative) protection of soils, nature and landscape [OCDE 1998; ARE 2005]. Moreover, in Switzerland we are now seeing the re-emergence of problems in areas that had shown positive developments over the last three decades of the 20th century. These include, in particular, new increases in atmospheric pollution, the repeated failure to respect residual flows in certain watercourses, the increase of urban waste produced, not to mention the rises in CO_2 production and energy consumption [OFEN 2005]. Even more worryingly, there are few indications that these policies have made any effective contribution to increasing the sustainability of our use of renewable and non-renewable natural resources. On the contrary, the current debates on the (un)sustainability of their use show clear signs of a very limited contribution of these policies to the

[4] *Immissionsschutzpolitiken* in German.

achievement of truly sustainable development, particularly in urban areas [OFS, OFEFP, ARE 2003].

As a result of these phenomena, observers now have an obligation to review in detail the conception of these environmental policies whose purpose is to protect natural resources. Based on the analysis of these policies, it is relatively easy to demonstrate that one of their main weaknesses is that these policies originate in – and again are often partly based on – rights of adjoining owners (*droit de voisinage*) [Knoepfel 2000b]. Thus their essential objective is to protect the environment and natural resources only from the effects of "immissions" or impacts originating from the emission of *pollutants*. It does not address *the effects triggered by other forms of exploitation* such as water withdrawal, clear cutting, or construction. According to this conception, it only becomes necessary to protect resources when the processes of extraction, exploitation and processing of natural resources give rise to emissions that are likely to affect the resources in question or other resources. Thus, any exploitation of (primary or recycled) natural resources that does not produce emissions that cause harm or discomfort to human beings or other resources will not be governed by environmental policy. Therefore, there is a risk that the successful implementation of an environmental policy that aims to fight immissions will pave the way for the "legitimate over-exploitation" of natural resources based on the principle of "the lower the emissions, the greater the admissible level of exploitation"[5]. When considered from the perspective of the management of natural resources, the real paradox of traditional environmental policies is encapsulated in this statement. In effect, very few environmental policies exist today that explicitly forgo this requirement that emissions be present. Indeed, this requirement does not exist in the case of policies for the conservation and protection of nature and the protection of landscape [Knoepfel 2000b: 199] which, according to the available data, are both among the least effective environmental policies – particularly because they encounter difficulties in making threats

[5] For example, improving water quality allows greater water withdrawal.

visible [Larrue and Knoepfel 1998: 192 ff.] and attributable to effectively "hazardous" activities which lends them a legitimacy in the eyes of those who are accustomed to fighting hazards affecting health or ecosystems. Furthermore, the landscape and biomass have very few clearly identifiable owners who are likely to institute proceedings in favour of their protection based on the "vigilant neighbour" model.[6]

These policies are characterized by yet another weakness. Since the 1980s, environmental policy analysts have highlighted the need to take into consideration the spatial and environmental repercussions of policies that have an influence – voluntary or involuntary – on the behaviour of potential producers of emissions. They emphasize the fact that many non-environmental policies exist that contribute directly or indirectly to the generation of considerable burdens on the environment. Urban development (soil), transport (air and urban surfaces), agriculture (water, air and soil), economic promotion (all areas combined) and energy (water, landscape, air) were also analyzed in terms of their spatial and environmental impacts. These analyses clearly show the power and increasing dynamics of these exploitation policies which are capable of challenging the limited successes of environmental protection policies [Benninghoff *et al.* 2004: 697 ff.].

The limits of traditional environmental policies can also be explained by the fact that they generally only concern a single use of a resource, i.e. the absorption, dilution, decomposition or transport of noxious emissions. However, as we know from resource economics, all resources are likely to be subject to a large number of different, and often simultaneous, uses ("goods and services") that potentially compete with the use of the resource for the absorption of pollutants, which is normally regulated by traditional environmental protection policies [Knoepfel

[6] The absence in many cases of a "neighbour" likely to intervene in the event of damage caused to their property was historically one of the main arguments in favour of the introduction of the right of appeal by environmental protection and nature conservation organizations into the Swiss Federal Law on the Protection of Nature and the Landscape (*Loi fédérale sur la protection de la nature et du paysage*) of 1 July 1966 (art. 12), RS 451.

and Savary 2002]. Thus, it is possible to treat wastewater using turbines and use the same water to store thermal energy. Similarly, polluted and non-potable water can be used for agricultural irrigation (as long as the pollutants it contains are not toxic) and polluted air can even be used as a medium for aeronautical activities. It is interesting and important to confirm the existence of a clear causal link between the progressive recognition of the utility and, hence, the status of the goods and/or services among the different services provided by a natural resource, on the one hand, and the creation of very varied policies whose precise objective is the regulation of (homogeneous or heterogeneous) rivalries between the different uses and/or groups of users, on the other. However, in most cases, these policies concern a specific use, which is generally considered from the perspective of the regulation of activities[7] and the relations between actors-users rather than from the perspective of the resource itself. Moreover, this is the reason why these policies are still rarely coordinated today and why they are often managed by specialized administrative bodies. These administrative bodies seldom have regular contact with each other, which would enable truly coordinated management of natural resources and the various, already regulated goods and services produced by them [Knoepfel 1995].

As we shall show in the next section, this resource-economics-based approach has gained significant relevance since the birth of the concept of sustainable use of natural resources. This concept highlights the homogenous, integrated, and interdependent character of both a resource system and the goods and services derived from it, even though the latter are regulated by numerous specific policies. Thus, there is no reason to consider, for example, the urban resources located within the territory of a town or city and those located outside of urban centres

[7] These activities are normally regulated in accordance with a sectoral use logic based on economic promotion within agricultural, fishing, forestry, energy, transport, industrial promotion, tourism and urbanism policies which will be studied as part of a European project proposed in April 2005 within the Priority Programme 7 "Citizens and governance in a knowledge based society" under the title "Suitable regimes for sustainable resource management – SR^2" (coordinator: Peter Knoepfel, IDHEAP) (project unfortunately not financed).

separately as, in reality, they often belong to the same resource system. Similarly, it no longer makes sense to consider and, hence, regulate the uses of each of the goods and services provided by a single resource separately. In fact, the regulation of one of these goods and services may undermine the regulation of all of the other goods and services during periods when the resource in question is subject to over-exploitation. The artificial division resulting from the current organization and structuring of policies between resources exploited for production within multiple industrial or urban metabolisms, on the one hand, and resources used on the basis of their absorption capacity, on the other, is hardly compatible with the objective of their sustainable management, the principles of intergenerational and interregional solidarity, and the integration of the global in the local [Di Giulio 2004: 151 ff.; OFS, OFEFP, ARE 2003: 12 ff.]. Thus, the perspectives of all of the users of all of the goods and services of a single resource must be taken into account. Such an "actantial" approach [Berthelot 1990: 76; Scharpf 1997] should include all of the rules (= institutions) that influence the users of a single resource and, hence, their behaviour. This group is almost always significantly larger than that of the producers of emissions who constitute the target group of traditional environmental policies

.

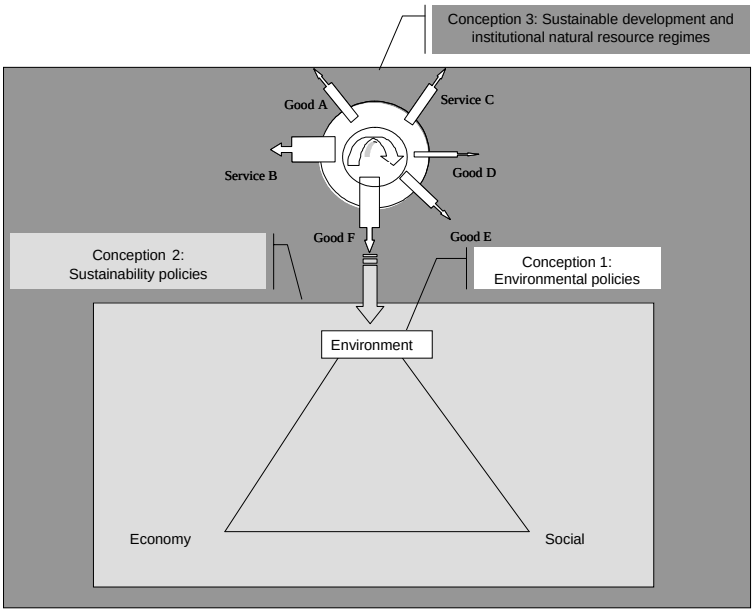
2 The Genesis and Development of the Political and Institutional Regulation for the Use of Natural Resources

2.1 Basic concepts

Taking the above into account, the management of natural resources should concern itself with renewable natural resources since non-renewable resources are basically – and in some cases probably incorrectly – considered easier to substitute with the help of technological processes and innovations [O'Connor 2002; Devlin and Grafton 1998; Bromley 1991]. Ensuring the sustainable existence of a renewable resource constitutes the best guarantee that it will be possible to obtain the goods and services derived from it now and, above all, in the future. It is not possible to continue exploiting a natural resource whose stock has reached a point whereby the quantity of "units" or "flows" available for extraction or withdrawal is heading to zero due to over-exploitation in the past.

The sustainable management of these resources must incorporate both the boundaries of the resources and all of the goods and services derived from them. This last and, at an initial glance, innocuous statement has fundamental implications for the way in which the sustainable management of local/regional resources is conceived. Basically, it is possible to identify – very schematically – three levels of conception of the sustainable management of local/regional resources which vary according to the extent of their requirements (Figure 1): i.e. the "traditional" conception of environmental policy (conception 1); the conception expressed in the political discourse of sustainable development (conception 2); and the scientific conception of sustainability, which is based on a truly resource-based approach (conception 3).

Figure 1
The different levels of conception of sustainabiliy



The "traditional" conception (1) of environmental policies is undoubtedly the least sustainable of the three to the extent that its rationale is limited to the *restriction of pollutant emissions*, i.e. in many cases the restrictions are still applied without consideration of the actual absorption capacity of the resource. This is best illustrated by the often almost uncompelling and, in certain cases even, non-existent relationship between the definition of emission standards and environmental quality standards.

Conception (2) conveyed via the discourse and, when present, implementation of sustainable development policies consists for the most part in the practice in a tentative to coordinate environmental requirements

(which are still essentially based on the restriction of emissions) with the social and economic requirements or interests affected by these restrictions. The ecological requirement of the famous sustainability triangle incorporates all of the legal norms defined in the traditional environmental legislation, which are often very detailed and contain quantifiable indicators. However, unlike traditional policies, this ecological requirement targets not only the producers of sources of environmental nuisance for an area, but also those who produce emissions that are harmful to the resources in their possession. What is clearly involved here is the reinforcement of the protective potential of these traditional environmental policies, despite the fact that it remains within the scope of a relatively weak conception of sustainability.[8]

In fact, the empirical processes relating to "sustainable development" basically focus their attention on the *modes of uses of goods and services provided by natural resources*, i.e. the regulation of these uses are supposed to guarantee the ecologically, economically and socially sustainable and equitable *exploitation* of resources [Di Giulio 2004: 49 ff.; Conseil fédéral 2002: 9ff.; United Nations 2002; World Commission 1987]. However, this focus takes for granted that it is possible to obtain a sufficient quantity of resource units in the form of goods and services, yet this is far from evident. In reality, there is nothing to prevent the extraction or use of a resource in a way that is "ecological" in the sense of traditional environmental policies (i.e. one that *is not a source of environmental nuisance* to human beings, animals and plants and their biocenosis) but that is ultimately unsustainable since it could lead to the over-exploitation of the resource which is likely to impair its capacity to regenerate. Thus, as previously mentioned, parts of sustainability policies do not actually prevent the over-exploitation of a resource in the "strict ecological sense".

[8] According to the authorities responsible for this issue [OFS, OFEFP, ARE 2003: 14 ff.] the Swiss federal government's strategy starts from a position of socalled "weak sustainability" [Knoepfel, Münster 2004: 80 ff.]. The latter "sanctions capital compensation but only if the use of capital is not irreversible and does not represent a threat to the survival of humanity, an area normally governed by limit values" [*ibid* : 80].

The second postulate of sustainable development, i.e. that of *economic sustainability*, encompasses the economic use of the resource both on the micro-economic level of the actor using the resource (e.g. by companies) and on the macroeconomic level of the economic system in its entirety. Economic sustainability generally refers to the viability of the production system and companies or the maintenance of their capacity to produce goods and services while producing additional value in a general context characterized by the increasing scarcity of resources and, equally, increasing marginal costs. Based on the example of industrial ecology [Erkman 1998], this postulate materializes in particular through legislation (current and planned) involving obligations to recycle or reduce the quantity of waste and emissions produced from reusable materials or to prioritize the allocation of raw materials during periods of scarcity. While traditional environmental protection requirements are relatively clear today since they are based *inter alia* on scientific experience, economic sustainability is more politically and scientifically controversial. Even outside of the eternal debate of planned economy versus market economy,[9] now less virulent than it was in the 1960s, the question of the allocative optimization of production factors within what is considered generally a market economy remains controversial. This is why state allocation mechanisms based on authorizations, licenses and quotas have been maintained for certain goods and services whereas the allocation mechanisms set by the market constitute the rule for others. Mixed systems can also be observed that combine a state-imposed global quota on the extraction/withdrawal of resources (in particular for goods and services considered at risk due to the over-exploitation of the resource) and the distribution of these quotas among individual users on the basis of market mechanisms or, in some cases, their allocation by authorities [Kirchgässner 2002;

[9] According to the representatives of the neo-Marxist movement of the 1960s, only collective, state or community planning would be effectively capable of combating the abusive exploitation of our natural resources and manufactured resources, referred to using the generic term of "factors of production". This postulate would affect land/soil in particular and would lead to various propositions of its nationalization.

Varone 2002]. The fact remains that the concretization of the principle of economic sustainability (and equally of social sustainability) will remain significantly more controversial than that of ecological sustainability and this is clearly evident in the difficulty that exists in formulating concrete postulates and deducing universally accepted indicators for it [Knoepfel 2005a].

A similar, and probably even greater, problem arises when it comes to the concretization of the third postulate, i.e. that of *socially* sustainable development. In reality, the definition of genuine rights of equal access to the goods and services derived from natural resources *in situ* is far from being accepted by all actor-users and is the subject of serious conflict between the holders and non-holders of such rights [Barnes 2001; Behan 2001; Bollier 2002; Radin 1996]. The current debate on the limits of the welfare state and the past controversies surrounding the enshrining of social rights in national constitutions and the European Constitutional Charter bear witness to this. The absence of real legal norms and clearly quantifiable indicators concerning the minimum rights of access to the different vital goods and services supplied by natural resources is a clear sign of the highly political issues concealed behind the notion of socially sustainable development.

Finally, as suggested by the distinction between the three sustainability conception levels represented in Figure 1, the sustainability policies emerging over the past twelve years or so undoubtedly constitute an important initial step in the direction of sustainability. However, in their current state of development, they are not in a position to guarantee the truly sustainable management of (natural) resources, in the majority of cases. The situation in which we find ourselves today regarding policies for ecological, economic and social sustainability is comparable to the paradox of traditional environmental policies referred to in section 1. In fact, there is a significant risk that the pursuit of social, economic and even ecological sustainability at the level of selected goods and services will ultimately lead to the non-sustainable management of the resource. This is the case when the extraction and distribution of the resource's goods and services are carried out on the

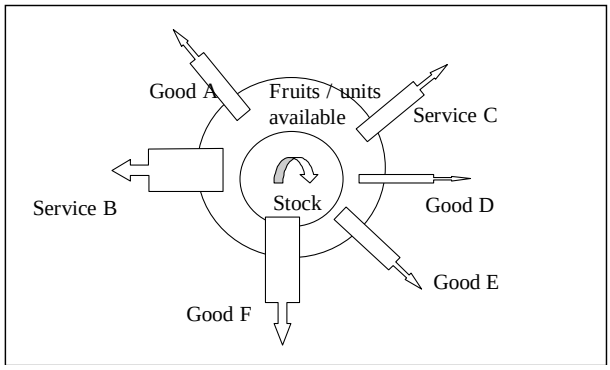
basis of the simple logic of pollution limitation or reinternalization of negative externalities ("polluter pays" principle), i.e. independently of the estimated reproduction capacities of the different resource systems.

In our view, the sustainability postulate (conception 3) requires the clear distinction between the sustainability of the resource (system) and the ecological, economic and social sustainability of its different uses. In reality, it is only possible to exploit the goods and services of a resource sustainably if its reproduction capacity is not put at risk. Such an objective can only be attained if sustainability policies undergo a fundamental conversion, which they have hitherto mostly failed to do, from the logic of control and restriction of pollutant emissions (management and reinternalization of negative externalities) to policies focusing on the management of the stocks and reproductive capacities of resource systems. It should be noted that a shift of this kind comes down to recognizing the primacy of the ecological pole over the economic and social poles of the sustainability triangle and in that reminds us of a basic principle – at the same time as an obvious fact – of the heuristics of sustainable development, a principle too often forgotten in the context of the development and implementation of contemporary sustainability policies: in other words the ecological sustainability of different resource systems constitutes an indispensable (but far from sufficient) condition for the existence of the sustainability of social, economic and ecological uses of the goods and services provided by resources. The latter can only be guaranteed if all of the users jointly ensure that the quantities they extract or withdraw from a resource do not reach the limit of the reproductive capacity of the resource system, a requirement that should in principle give rise to inconveniences for all users (the symmetry of sacrifices made being one of the conditions of social sustainability). Given that all natural resources today are at least in part the product of human activities, this objective often is only attainable under the condition that the appropriators and users limit the quantities of goods and services they extract or even contribute actively to the

conservation of the resource through investments coming from human, manufactured or cultural capital.[10]

Figure 2 reminds us, that each resource produces different goods and/or services that change in time and space according to the requirements of its users. The quantities of resources available for withdrawal or extraction (to satisfy the needs of users in terms of goods and services) depends on the size of the stocks and the (variable) reproductive capacity of the resource systems ("fruits").

Figure 2
Goods and services (G&S) of a natural renewable resource



Source : Knoepfel *et al.* [2001 : 18]; Kissling-Näf and Varone [2000: 238].

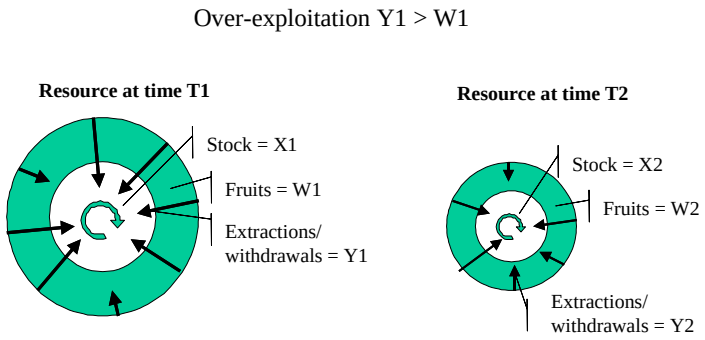
As stated in the introduction, the withdrawal or extraction of these goods and services may lead to situations of exclusion and rivalry or, conversely, to simultaneous complementary and non-rival uses. It is

[10] According to the terminology of the World Bank [World Bank 1995]. Cf. Knoepfel [2005b].

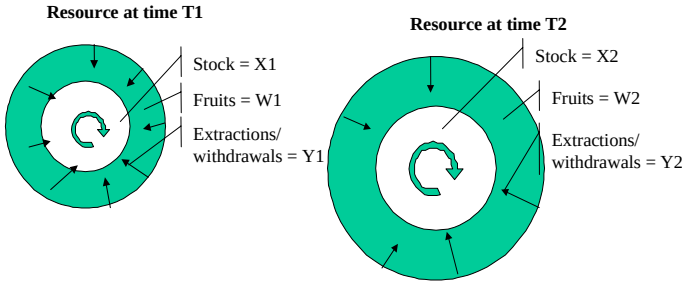
possible to record for each natural resource analyzed a list – whose length will depend on the resource and the state of (economic, cultural etc.) development of a society – of the goods and services extracted [Knoepfel *et al.* 2001: 65 (soil); 2001 : 105 (water); 2001 : 146 (forests); Rodewald *et al.* 2005: 56 ff. (landscape)]. Based on these lists, the researcher can then identify precisely the uses, users and, moreover, the rules that legitimize (i.e. authorize) or delegitimize (i.e. prohibit) the empirical uses in question.

Figure 3 presents in schematic form the link between the stock and extractions/withdrawals of a natural resource, thus demonstrating the mechanisms of over-exploitation or under-exploitation, both of which are likely to affect the reproductive capacity of a natural resource.

Figure 3
Over and under-exploitation of a resource



Under-exploitation Y1 < W1



Source: Knoepfel *et al.* [2001: 21].

2.2 Origins of the need for regulation of the uses (G&S) of a resource: the contribution of institutional resource economics

It is our belief that in order to implement the principle of sustainable development on the two levels outlined in Figure 1, conceptions 2 and 3, it is not sufficient to formulate individualized and specific regulations for each of the goods and services produced by a resource through public policies alone. On the contrary, a glance at the origins of the modes of political regulation shows that the public action likely to guarantee or re-establish the reproductive capacity of the resource in question should also govern all of its units ("fruits") considered extractable in a given time or space. This principle should be applied independently of the object of extraction (i.e. specific good or service) and implemented through a global extraction quota that is acceptable for the entire resource. Given that this quota may vary in time and space, the public action must regulate the way in which this quota is defined and also the way choices are made in the case of rivalries between the various goods and services extracted regarding their quality and quan-

tity considered legitimate. Thus, for any regulation considered, three successive operations should be implemented, all of which constitute fundamental political choices.

Firstly, a maximum global quota should be defined for the extraction/withdrawal of resource units that incorporates both quantitative and qualitative criteria that are compatible with the ecological requirements for the renewal of the resource system. We suspect that the definition of such a quota would constitute a central political issue to the extent that it expresses the conception of sustainability (i.e. strong, weak, etc.) adopted by a given society. *Secondly,* this global quota should be shared between the different rival uses (goods and services), ideally as a function of the principles of social and economic sustainability. *Thirdly*, the quota of resource units attributed to a specific good or service should again be distributed between the different user groups and, if possible, also on the basis of the principles of social and economic sustainability.

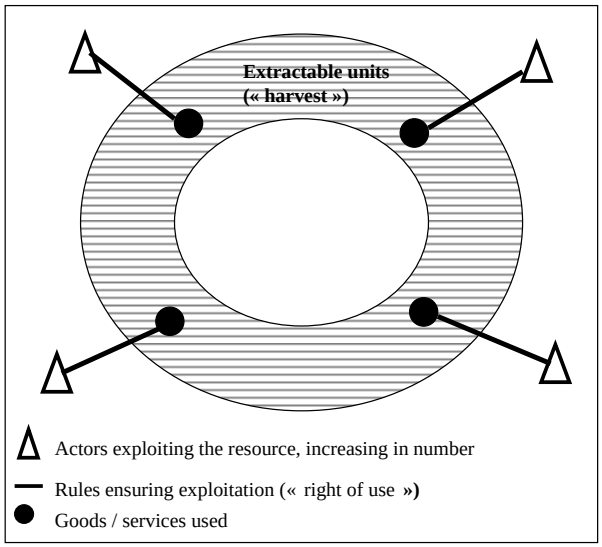
It is clear that such regulations tend to emerge where the need for them is felt and, historically, prior to the advent of the sustainability debate [Ostrom 1990]. All together, they constitute what we refer to as an *institutional resource regime (IR).* Based on the local characteristics of these regulations, such regimes may lead to either the destruction of a resource or its conservation and/or exploitation in a way that is considered as sustainable to varying degrees. Thus, these regulations are primarily observable empirical realities that are more or less "adequate" from the normative perspective of the postulates of sustainability. They incorporate both regulations associated to policies and the rights of ownership based on constitutional principles or private law. They emerge when a sufficiently powerful actor demonstrates the need for them, most frequently as a result of a significant deterioration in the state of a resource.

Theoretically, it is possible to model the emergence of regulation procedures while differentiating between different stages of resource use, moving from a so-called "normal" situation involving the use of goods and services (Phase 1a) to a situation of uncontrolled increase in the

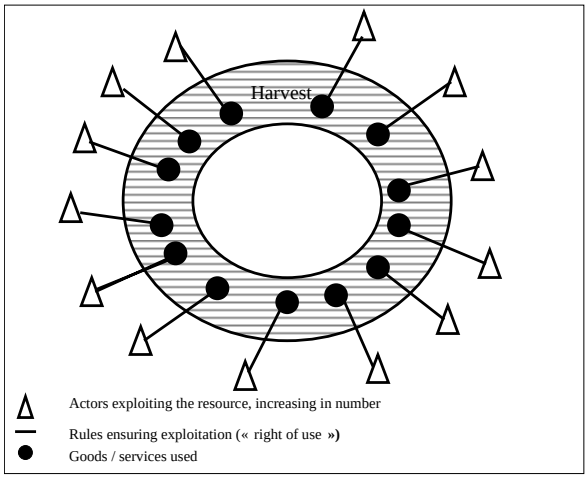
extraction of certain goods and services likely to exceed the annually acceptable limit (Phase 1b, Fig. 4), and ending up with a situation in which the reproductive capacity of the resource is called into question (Phase 2). In such situations, we see the initial attempts at quantitative and qualitative regulation of these extractions (i.e. global quota) and this process corresponds to the political "birth" of the resource (Phases 2 and 3). The restriction on the allowable extraction ultimately involves the adaptation of the behaviour of individual actor-users who are forced to limit their actual extractions (Phase 4). This process is presented schematically in Figure 4.

Figure 4
Schematical presentation of the process of exploitation of the political regulation of natural resources

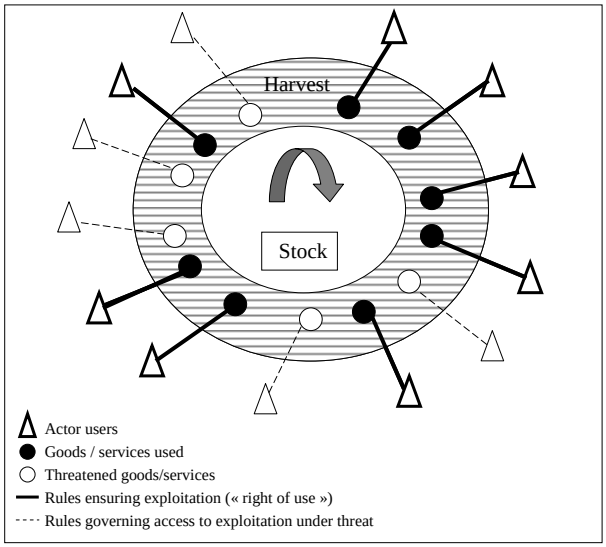
Phase 1a: Initial unproblematic exploitation



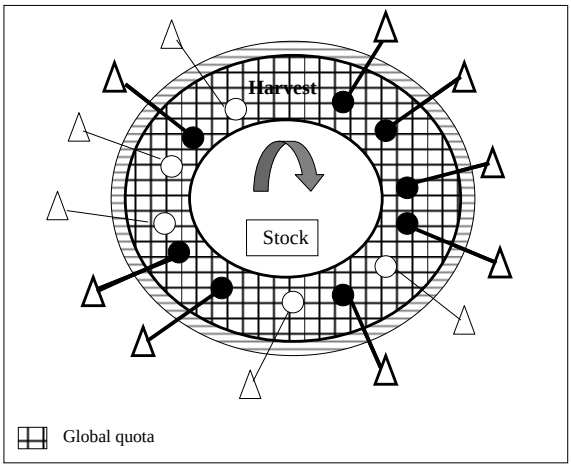
Phase 1b: "Unchecked" growth in homogenous and heterogeneous uses



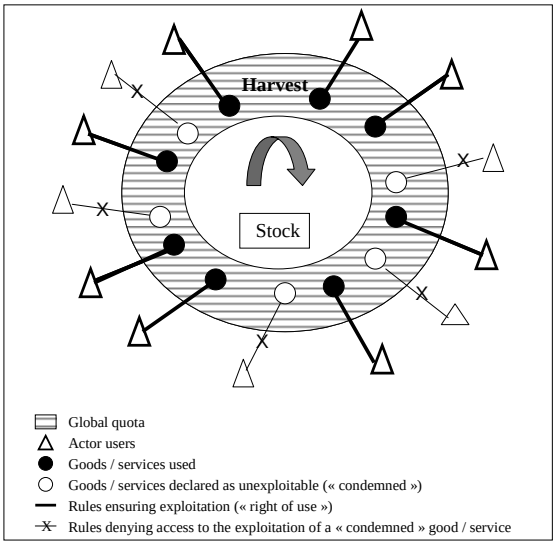
Phase 2: Scarcity and political "birth" of the resource



Phase 3: Political definition of a maximum harvest (global quota)



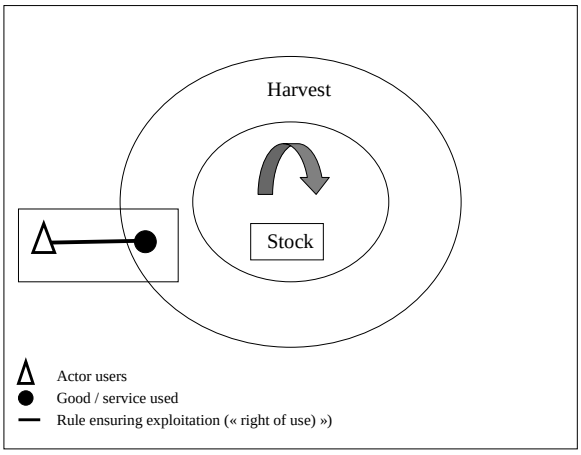
Phase 4: Redefinition (quantitative and qualitative) of the B&S



2.3 The basic elements of the institutional regime

In Phase 2, at the latest, we see the emergence of more or less robust and exclusive regulations whose objective is to guarantee actor-users stabilized access in time and space to one of the specific goods or services that they appropriated or claimed in the preceding phase (Phase 1b). These regulations provide a precise definition of the good or service in question, and – in an initial period independent of truly resource-based considerations – the *property and use rights* to this good or service as well as the modes of its attribution to different groups of users. The aim of these regulations consists in controlling the behaviour of actor-users by means of (stabilizing or modifying) intervention in the relationship that previously existed between them and the good or service in question. This is achieved through the attribution of universally recognized use rights. These relationships may be created, quantitatively and qualitatively redefined, eliminated etc. by means of either the modification of formal property rights (Civil Code), the modification of rights of disposal and use, or the redefinition of the obligations attributed to or incumbent upon the actors within specific policies (e.g. water withdrawal concession, planning permission etc.). Figure 5 shows a schematic presentation of this right of use which allows actors who hold it to refuse all other actors, either permanently or temporarily, exclusively or selectively, the access to the good or service in question and, by doing this, to stabilize and render predictable the modes of their own access to the good or service in question [Bromley 1991, 1992; Devlin and Grafton 1998; Nahrath 2003a: 19 ff.].

Figure 5
Regulation of individual use rights

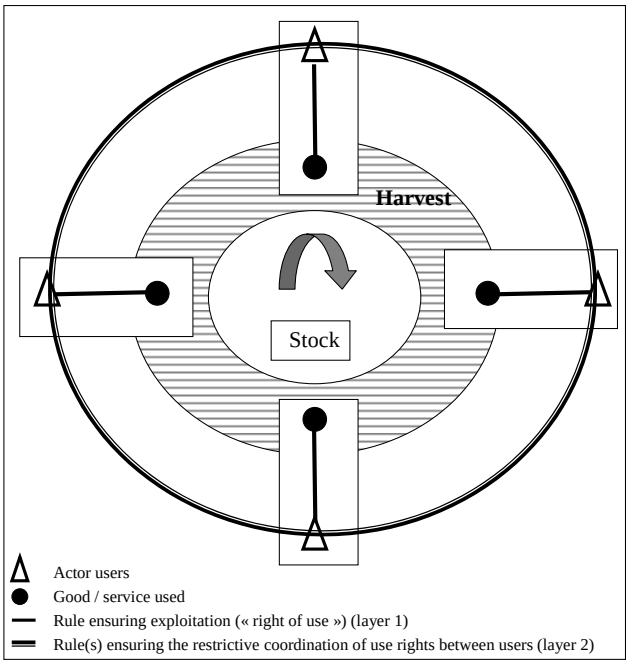


This need to formulate rights may emerge prior to the arrival of any threat to the resource in question and generally results from the need to stabilize and render more predictable the relations between an "owner" and his or her "property" , in particular for economic reasons. This need is found at the origin of Roman Law, in the phenomenon of "enclosures" and, again, in the generalization of private or exclusive property after the French Revolution [Aubin, Nahrath, Varone 2004].[11] Obviously, this need would become even more evident when the threat of over-exploitation of a resource exists. Under such increasingly frequent conditions, the main concern of legislators is not only guaranteeing this individual right in the interest of maintaining the stability of the conditions necessary for economic activities, but rendering it compatible with the need to maintain the resource and its repro-

[11] Such a need even exists among nomad populations who frequently integrate forms of ownership, possession, right of usufruct etc. into their legal order. [Hagmann 2004].

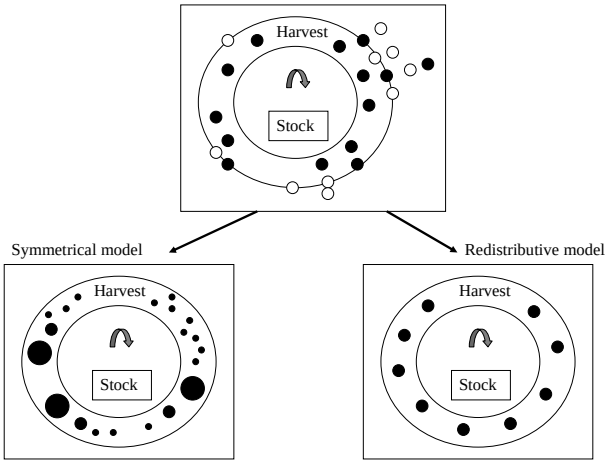
duction capacity as a common good [Bromley 1991; Devlin and Grafton 1998; Holzinger 2002; Ostrom 2002]. For this reason, in the case of a real scarcity of one of the resource's goods and services which risks leading to its over or under-exploitation (excessive or under-use of the global quota), the need arises for a second layer of regulation whose aim is to alter the behaviour of the actor-user based on the public problem of the survival of the resource. Therefore, its objective consists in the regulation of the behaviour of actor-users based on a politically defined global quota. In fact, this second layer of regulation should dominate the first. However, the mere existence of such rights of use is a precondition for any public action that aims to regulate all of these uses: it is only possible to change the behaviour of actor-users institutionally on a global level if their uses of the resources were previously regulated individually through the rights of use. Thus, one of the main conditions for the efficacy of a policy goes back not only to the instruments the policy has at its disposal, but also and probably primarily to the characteristics of the target groups it is aimed at: it has a greater chance of having a substantial effect on the problem to be resolved if it targets the actors who hold the effective rights of use to the resource. In order to be able to accomplish its aim of regulating the entire resource system and not only one good or service in isolation, this second layer must be capable of relating in a sustainably and globally restrictive manner all those in possession of rights to the resource (Figure 6).

Figure 6
Regulation of the behaviour of the holders of collective use rights



By doing this, these rules construct an institutional mechanism that is capable of defining and redefining the individual use rights corresponding to the quantities – variable in time and space – of resources, the admissible extraction of which is defined politically. In other words, this regulation should provide a restrictive mechanism for the attribution, redistribution, and quantitative and qualitative redefinition of individual quotas on the basis of global quotas [Knoepfel 2000c]. Figure 7 presents in schematic form two possible opposing mechanisms for the shifts from a global quota to individual quotas.

Figure 7
Models for shifts from a global quota to individual quotas



The "symmetrical" model considers all of the goods and services used *a priori* as "legitimate" and contents itself with redefining them *in a restrictively symmetrical* way. In such a model, which is based on the symmetry of sacrifices, the inequalities with respect to access and rights of use of the resource are maintained proportionally in the case of reduction of the global quota and, therefore, of individual quotas. Conversely, the "redistributive" model takes the view that some uses are more crucial or simply more opportune than others and that these should be prioritized in the case of a reduction of the global quota. Therefore, the shift from the global quota to the different individual quotas (through goods and services) involves a choice that is politically more costly and consists in the reallocation – possibly through the expropriation of previous holders of use rights – of the resource units that were previously allocated to secondary uses to the more important uses.[12]

[12] Cf. for other modes: Varone [2002].

3 Institutional Natural Resource Regimes (INRR): Theoretical Bases

As clearly stated in the first section, from both an analytical perspective and that of the reform of public action, traditional public policies for environmental protection inadequately account for the complexity of natural resource management, particularly within the relatively new framework of sustainable development. We need a new conceptual framework to facilitate a more suitable reading of this complexity while still maintaining the advantages of policy-based analysis with its focus on coalitions of actors, the resources at their disposal (political, social, financial etc.), and the institutions that structure the restrictions and scope of their actions [Knoepfel *et al.* 2001a: 70 ff.]. In our view, this analytical framework should also incorporate the insights from resource economics presented above and address the role of the use rights that actors hold for a given good or service. Moreover, it makes sense to link these different rights analytically by means of restrictive coordination mechanisms, thereby reflecting the physical links that exist amongst themselves as well as the reproductive capacity of a given resource system.

In searching for a conceptual framework capable of accommodating these sets of regulations – formal and informal, institutionalized or in the process of becoming so, centred on intentional actors whose behaviour is likely to be controlled or influenced by public policy [Berthelot 1990; Knoepfel *et al.* 2001a; Scharpf 1997] – we have found a suitable theory to complement that of public policies: resource institutional economics and property rights theory (cf. in particular Bromley [1991, 1992]; Devlin and Grafton [1998]; Endres and Querner [1993]; Ostrom [1990, 2000, 2002]; Schlager and Ostrom [1992]; Siebert [1983]). This approach is appropriately preoccupied with the issue of use rights, their definition, their allocation, and their redistribution. It addresses the rules governing the behaviour of the holders of property rights and consideres these rights not only from an economic perspective, but also, and above all, from that of the sustainable management

of natural resources. The crucial importance of property rights for the sustainable management of resources can be explained by the fact that the latter constitute *common property* or *common pool resources* [Holzinger 2002; Ostrom 1990], which, unlike public goods, are characterized by use rivalries and by the impossibility of excluding entire social groups from their enjoyment or exploitation; this impossibility is the result of either their physical characteristics or categorical normative imperatives. Therefore, for this branch of research, the critical collective action in terms of the degree of sustainability of our development resides essentially in the (good or bad) definition of these rights [Coase 1960], and in the (more or less adequate) mechanisms adopted for the allocation of these rights.

Thus, the combination of these two approaches enables us to describe, analyze and explain the problems of the sustainable natural resource management outlined above which, according to the preceding account, are rarely made compatible with the theoretical frameworks familiar to us as political scientists. For reasons explained elsewhere [Knoepfel *et al.* 2003: 31 ff.], we have named this new analytical framework "institutional natural resource regimes" (INRR). In accordance with the ideas presented in section 2, these regimes incorporate all of the formal and informal rules that regulate all of the different uses (in terms of goods and services) of a resource system in the context of a given area. The crucial characteristics of these regimes, which determine the sustainable or unsustainable character of resource management and use, can only be successfully identified through theoretical reflection and regular empirical observation.

To do this, the concept of institutional regimes combines the contributions of the theoretical approaches of policy analysis, on the one hand, and institutional resource economics, on the other, with a view to pro-

posing an analytical framework that can overcome their respective individual limitations (Table 1). [13]

The theory of property rights developed, in particular at the "Workshop in political theory and policy analysis" directed by Elinor Ostrom at the University of Indiana at Bloomington (USA), essentially results from the detailed analysis of institutional arrangements (mechanisms for the definition and attribution of property rights and for (auto) control of their implementation). These institutional arrangements are based on a communal definition of property (*common property*), as prevails, for example, in the case of irrigation systems, common pasture lands in the Swiss Alps (*Allmende*), fisheries, hunting leases etc., and have historically demonstrated their capacity to guarantee the sustainable use of a resource by local self-organized groups.

[13] Cf. for more details and literature: Kissling-Näf and Varone [2000]; Knoepfel *et al.* [2001a]; Knoepfel *et al.* [2003]; Nahrath [2003a]; Gerber [2005]; Bressers and Kux [2004].

Table 1
Contributions and limits of the policy analysis approach to the analysis of the political and institutional regulation for the use of natural resources

	Contributions (theoretical and normative)	Limits (theoretical and normative)[14]
Policy analysis/public action	• Conceptual instruments suitable for the analysis of the modes of state intervention/regulation (taking inton account the interventions of political-administrative actors). • Identification and analysis of the six products of a policy: problem definition (PD), political-administrative programme (PAP), action plan (AP), political-administrative arrangement (PAA), outputs and evaluative statements (ES).[15] • Capacity to conceptualize complex use situations, including heterogeneous rivalries (shared uses), in which policies play a central role.[16]	• Sectoral approach to the phenomena arising from the artificial logic of the division of the world produced by the policies themselves. • Difficulty in conceptualizing the coordination between *protection* policies and *use* policies. • Conception of environmental policies as remedial policies rather than preventive ones. • Focus on the management of pollutant emissions insufficient to guarantee the integrated protection and management of resources. • Failure to take property rights into account making it difficult to understand the main obstacles to policy implementation arising from the social and political resistance exerted by the target groups who hold property rights to the regulated resources.

[14] See section 1.
[15] Cf. Knoepfel *et al.* [2001b: 142 ff.].
[16] Cf. Table 3.

Table 2
Contributions and limits of institutional economics to the analysis of of the political and institutional regulation for the use of natural resources

	Contributions (theoretical and normative)	Limits (theoretical and normative)
Institutional resource economics/ theory of property rights	• Resource-based approach founded on the concepts of "resource" and "goods and services". • Capacity to envisage the coordinated and global management of the resource and all of its uses (anticipatory approach). • Clear conceptual definition of (ecological and economic) "sustainability". • Focus on the institutional arrangements and the property rights as form/vector/instrument of the regulation processes. • Establishment of an explanatory link between over-exploitation of resources and the absence of property rights (e.g. air, landscape, genetic resources, global commons etc.).	• The validity of the *common pool resources* (CPR) approach is limited to use situations involving a homogeneous group of users (common use), i.e. difficulty of analyzing situations involving multiple or shared uses.[17] • Ideological bias favouring solutions involving local and self-organized regulations (rejection of the relevance of market or state regulation). • Ignorance of state regulations (policies). • Reductive typology of property regimes due to the absence of legal analysis.

[17] Cf. Table 3.

One can hypothesize that there is a link between the type of use situations of a resource and the theoretical approach or approaches relevant to their analysis. Tables 1 and 2 demonstrate that the institutional economics approach is particularly well suited to use situations described as "common", in which several users find themselves in the position of rivals competing for one and the same good or service provided by a natural resource. Table 3 suggests that the institutional regimes approach is more relevant for the analysis of use situations described as "joint", in which several users find themselves as rivals with respect to the heterogeneous uses of one and the same resource. Contractual arrangements based on civil law are generally used for the regulation of the two other far less complex situations involving "individual" and "multiple" uses.

Table 3
Positioning of the INRR approach based on resource use situations with examples

Classification of use situations (based on the example of water)		Types of use (in terms of goods and services used)	
		Homogenous Uses	**Heterogenous Uses**
Number of users	**Individual** user or group of users	**"Individual use"** Example: (exclusive) use of a private source for the production of drinking water.	**"Multiple uses"** Example: construction of a communal dyke with the dual function of flood protection and constitution of water reserves.
	Several users or groups of users	**"Common use"** Example: division of a flowing water body between farmers within an irrigation system. ***Self organized Common Pool Resources (CPR) regime (Ostrom)***	**"Joint uses"** Example: definition of minimum flows to be respected by a hydro-electric power plant so as to protect the biotopes of the fish populations and to guarantee the supply of the irrigation system of farmers located upstream. ***Institutional Natural Resource Regimes (INRR)***

Source: Knoepfel *et al.* [2001b: 16], based on Young [1992: 103].

4 The Concept of Institutional Natural Resource Regimes (INRR)

The INRR concept as applied to the resources soil [Nahrath 2003a, 2003b]; water [Reynard and Mauch 2003; Bressers and Kuks 2004; Kissling-Näf and Kuks 2004], forest [Bisang and Schenkel 2003]; landscape [Gerber 2005; Rodewald *et al.* 2005]; air [Mariéthoz and Savary 2004; Savary and Knoepfel 2005] and built heritage [Knoepfel and Kohler 2005] is composed of two types of regulation (public policies and property rights). Its dynamic depends on two dimensions, *extent* and *coherence*, both of which may vary in time and space according to the type of regime that prevails. In this section, we shall examine the main characteristics of this concept and refer to more detailed publications for in-depth information.

4.1 Policies and property rights

The concept of institutional natural resource regimes is primarily a framework for the analysis of institutional arrangements concerning the regulation of the collective and individual uses of a resource. This regulation is generally highly complex and composed of legislation and parliamentary, administrative or legal implementation decisions originating from several levels of the state (i.e. municipal, cantonal, federal and sometimes even international). It brings together the public rules, whose objective is the regulation of the behaviour of actor-users of goods and services originating from a resource system, the boundary of which is generally regional. These rules appear either in substantial policies intended to tackle collective problems associated with the protection or exploitation of the resources in question or in the basic property rights order[18] which is far more stable as it is based on (*quasi*) constitutional decisions or civil law (Swiss Civil Code) and rooted in political convictions that concern fundamental rights, social justice, and

[18] *Eigentumsrechtliche Grundordnung* in German.

the basis of the economic, political and social functioning of our society. An institutional regime represents a combination of these two types of regulation, i.e. (a) policies contained in what we call the *policy design* (PD); and (b) all of the property rights contained in what we call the *regulatory system* (RS). The contribution of these two types of regulation may vary significantly according to the resources in question and historical periods of the development of a regime, which is why it is possible to identify historically regimes that are essentially based on the regulatory system ("property rights driven regimes") and, conversely those based on policy ("policy driven regimes").[19]

Policies (policy design)

The policies that constitute an institutional regime contain all of the substantial and institutional elements relative to the programming and implementation of all of the different use and protection policies affecting the management of a resource. The different constitutive elements of this kind of policy design are:[20]

- The *definition of the different collective problem(s) to be resolved* based on the periods being analyzed, and the different objectives sought by the related state intervention. The policy design is often the product of a historical process involving the sometimes uncoordinated accumulation and sedimentation of the successive definitions of the collective problems to be resolved.
- The *causal and intervention hypotheses* forming the causal models, which change as a function of the variations in time and space of the definition of the problems to be addressed. The causal model defines the actors (target group) considered responsible for the existence of the problem and the modes of intervention believed capable of producing the desired changes in the behaviour of the target group(s), thus enabling the resolution or attenuation of the

[19] Kissling-Näf and Varone [2000b].
[20] Knoepfel *et al.* [2001: 101 ff.].

problem and hence an improvement of the situation of those who suffer due to the existence of this problem (i.e. end beneficiaries).

- The *target groups* and the *beneficiaries* of the various public policies constitutive of the policy design that form, together with the *intervening political-administrative actors*, the "basic triangle" of policy actors.
- The *instruments* (regulatory, economic, persuasive, etc.) produced according to the different intervention hypotheses and used in the implementation of the policies in question.
- The *political-administrative arrangements* involved in the implementation of the policies in question. These arrangements generally involve one or more municipal, cantonal and/or federal administrative services with a portfolio of various resources and are more or less coordinated (horizontally or vertically) through administrative procedures.
- The actual *outputs* of public policies take the form of individual and concrete acts of application in the field of political-administrative legislative programmes.

Table 4 presents the different policy elements and provides a few examples using policies concerning the resource water.

Table 4
Regulation through policies: the elements of the policy design

Policy design **(PD) (all of the policies governing the use and protection of a resource)**	**Examples: resource *water* (historical evolution 20th century[21])**
Definition of collective problems to be resolved and objectives of the state intervention	• Floods • Pollution of water bodies • Strong increase in the quantity of water consumed per capita, reduction of groundwater levels • Drying up of water bodies and destruction of aquatic ecosystems down stream of dams • Diffuse pollution of surface and underground water bodies (run-off and elutriation of agricultural soils)
Causal and intervention hypotheses	• Correction of water courses and draining of wetlands • Mechanical reoxygenation of lakes • Systematic treatment of waste water prior to disposal • Reduction of pollutants contained in industrial and household water • Introduction of the "polluter pays" principle • Fight against non-point source pollution due to intensive agriculture • Obligation to maintain a minimum flow in rivers • Renaturation of water courses
Target groups	Industries (in particular chemical industries), households, dam operators, farmers, owners of waste disposal sites and contaminated sites etc.
Instruments	• Mandatory connection to a treatment plant • Ban on phosphates in detergent products • Measures for the extensification of agriculture, restricted access to fertilizers • Minimum flow rates

[21] According to Reynard *et al.* [2001: 101 ff.].

Policy design (PD) (all of the policies governing the use and protection of a resource)	Examples: resource *water* (historical evolution 20th century[21])
	• Purification taxes • Separation of clean and waste water collection
Political-administrative arrangements	• Regional and local implementation • Creation of specialized administrations
Outputs	• Concessions for water withdrawal • Bans on the spreading of manure
Policies constitutive of the *policy design*	Infrastructure policies (flood banks), agricultural policy, policy for the qualitative protection of water, spatial planning, energy policy, nature and landscape protection policy, environmental policy etc.

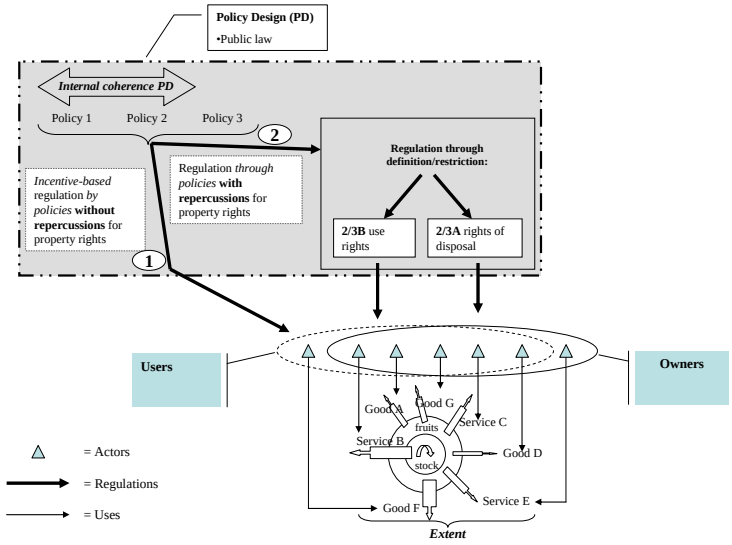
Public actors mobilise existing policies or newly created ones (change in the institutional regime) to modify the behaviour of the actor-users of a resource on the basis of the two following types of intervention or regulation:

- *Type 1 modes of regulation:* This involves the implementation of incentive-based instruments that do not have any impact on the content of the property and use rights of a resource's actor-owners and/or actor-users. This mode of regulation includes such instruments as information campaigns, the payment of subsidies in exchange for the desired behaviour (e.g. specific ecological services), tax relief (e.g. for cars fitted with a catalytic converter), etc.
- *Type 2 modes of regulation:* This involves the implementation of instruments with perceptible impacts on the rights of disposal and/or use of actor-users by means of clarifications (often restrictive) of the content of these rights. The most widespread examples of intervention involving rights of disposal are the restrictions on the circulation of property titles in the form of bans on the sale or purchase of these titles by certain categories of buyers (for example, bans on the sale of agricultural land to non-farmers or

on the sale of a plot of land to individuals intending to use it for the construction of a holiday property etc.), or restrictions on rights of rental or transfer of a property to people who are not suitably qualified to take care of it. Far more common, however, are the multiple and very varied restrictions on use rights such as, for example, restrictions on construction, on the emission of atmospheric pollutants or liquids, on harvesting (wood, rare plants and game), and on rights of access (to lakeshores, forests and fragile biotopes). These restrictions are aimed at actor-users who hold formal property title or rights of disposal or of derived use (concessions, leases etc.).

Figure 8 is a schematic representation of these two modes of regulation and intervention based on public policies (policy design).

Figure 8
Regulation of resource exploitation through the policy design (PD)



Source: Knoepfel and Nahrath [2002].

Property rights (regulatory system)

A property regime (or regulatory system) is composed of all of the formal property rights, as well as all of the rights of disposal and use arising from them, that apply to a resource. The content of these disposal and use rights depends on the definition of property used by the society in question (e.g. private, collective/communal) and applicable to this resource. An analysis of the property regime applies just as well to the entire resource system as it does to the individual units used to provide the different goods and services.

Table 5 shows the range of regulations based on property rights (components of the regulatory system) using the example of the resource ground/soil (ground law).

Table 5
Regulation through property rights: the components of the regulatory system

Regulatory System (all property rights)	**Examples based on the resource ground/soil**[22]
Formal property rights	Land ownership title
Rights of disposal	Right to: • sale • gift • rental (leasing) • mortgage • inheritance • etc. one's real estate.
Use rights	Right to: • construct on • deposit (waste) on • use (agriculture) • destroy • protect • etc. one's real estate.

When public actors consider these rights as ineffective, too costly in administrative terms, or simply no longer corresponding to the prevailing political values, they may try to resolve the problems associated with the use of goods and services through the modification of these rights. Compared to policy changes, such a strategy is sometimes con-

[22] According to Nahrath [2003a].

sidered more long-lasting, less fragile, and more likely to improve the predictability of these regulations, as well as the framework conditions that promote a good climate for investment. This kind of more radical and sometimes even revolutionary change modifies the institutional regimes through the restructuring of their regulatory system on the basis of the following two possible modes of regulation and/or intervention:

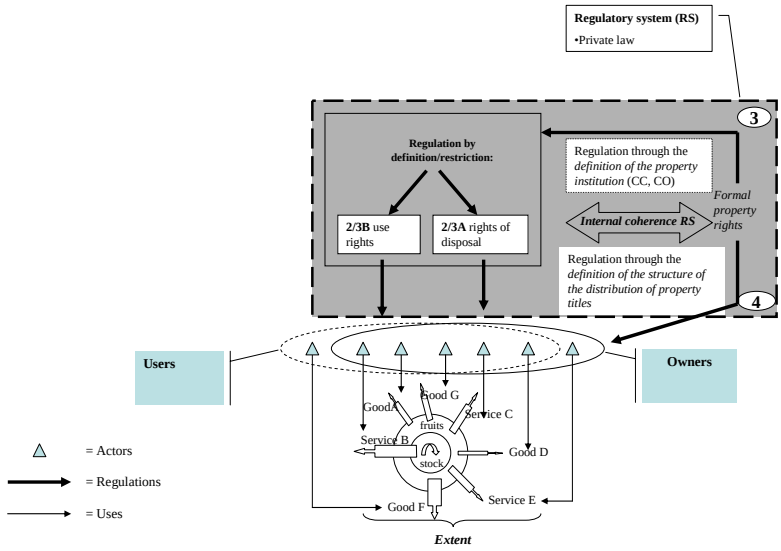
- Type 3 modes of regulation: This involves different types of possible modifications of the definition of the institution of formal property that have an impact on the scope and content of the disposal and use rights of all holders of such rights. The most important example occurred with the introduction of the Swiss Civil Code in 1907, which created a unified definition of property rights at the federal level and abolished in one fell swoop the old use and disposal rights, particularly in the area of ground law. More recent examples include the introduction into the Civil Code of the law of condominium ownership (1965) and the introduction of the new property regime (1969) through the Bodenrechtsartikel (constitutional guarantee of real estate property), which practically established the principle of the right of compensation in the case of material expropriation in the Swiss Federal Constitution.[23]
- Type 4 modes of regulation: This involves different possible forms of intervention of a general nature or, conversely, affecting a particular area whose objective is to redefine the structure of distribution of property titles. These modes may consist of both an intervention as radical as the privatization or nationalization of land for all kinds of reasons (increased economic efficiency, efforts to counteract speculation or concentration and de-individualization of property ownership, security of supply, etc.) and a more punctual and limited intervention consisting of formal expropriation (e.g. for the implementation of infrastructure projects) or targeted

[23] On this point, see Nahrath [2003a, 2005].

public property acquisitions (due to an active property policy at municipal level).

Figure 9 contains a schematic representation of interventions made through the regulatory system and affecting the modes of resource exploitation.

Figure 9
Regulation of resource exploitation through the regulatory system

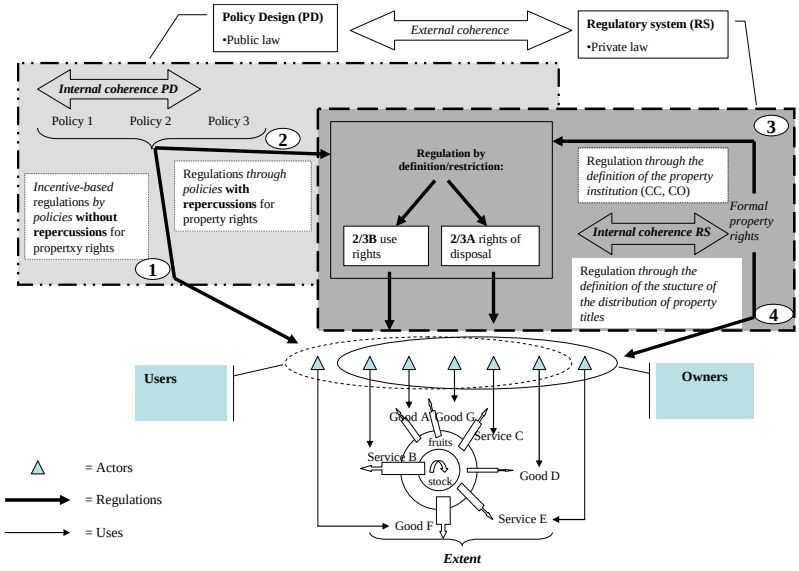


Source: Knoepfel and Nahrath [2002].

As clearly demonstrated in Figure 10, which combines Figures 8 and 9, the scope and content of the modes of regulation affecting rights of disposal (2/3A) and rights of use (2/3B) depend on the link between the two components of the institutional regime, i.e. the policy design and the regulatory system. These two modes (2/3A and 2/3B), which

are by far the most common in practice, constitute the core of the institutional regimes of the principle natural resources.

Figure 10
The INRR as a combination of the modes of regulation by policies and modes of regulation by property rights



Source: Knoepfel and Nahrath [2002].

The main forms of resource regulation (in terms of frequency, scale and impact) consist of the restriction of disposal and use rights (2/3A and 2/3B). These interventions are located at the junction between policies and property rights, which clearly demonstrates the fundamental interdependence of these two forms of political regulation. Only an approach based on "institutional regimes" can take this interdependence into account (Table 6).

Table 6
Summary: INRR

Institutional Resource Regime	
Policy Design (cumulation of all use and protection policies)	*Regulatory System (cumulation of all of the property rights concerning the resource and its uses)*
Definition of the social problem and political objectives	Formal property rights
Causality model (causal and intervention hypotheses)	Rights of disposal
Target groups	Rights of use
Instruments	
Political-administrative implementation arrangement	
Outputs	

Source: Knoepfel *et al.* [2001b: 36]; Nahrath [2003a: 36]

4.2 The concepts of regime coherence and extent[24]

Institutional regimes may be defined and categorized on the basis of their specific characteristics, particularly with the help of the dimensions "extent" and "coherence" of a regime. On this basis, the concept of the institutional regime enables one to formulate hypotheses concerning the existence of causal relations between the characteristics of a regime and its contribution to the sustainable or unsustainable development of the resource, to whose regulation it contributes.

The dimension referred to as the "extent" of a regime concerns simply whether or not the different goods and services of a resource actually

[24] In accordance with Knoepfel [2003]. Cf. also Nahrath [2003a]; Bressers and Kuks [2004].

used are regulated. The analysis is based on the idea that the lack of regulation of the behaviour of actor-users, through a more or less precise description of use rights via public policies and/or property rights defined in a regulatory system, risks engendering strategic behaviours that can lead to the over-exploitation of the resource during times of scarcity.

Depending on the objectives pursued through the adoption of the INRR concept – whether for describing the general evolution of one or more resource regimes in time and space or, conversely, describing and analyzing a particular regime in action at a given place and time – the analysis will focus on the so-called "absolute extent" of the regime, on the one hand, and on its so-called "relative extent", on the other. The first makes it possible to take into account historical changes regarding the number of goods and services effectively regulated by the federal and possibly cantonal components of an institutional regime. Here, the absolute extent constitutes a good indicator for identifying periods of regime change corresponding to an increase or decreasing of the number of goods and services regulated by a regime. Moreover, it lends itself to international or interregional comparisons of regimes from the perspective of the number of goods and services effectively covered by such regulations. Conversely, the relative extent, which represents a quotient relating the number of goods and services regulated with the number of goods and services actually used in a given area at a given moment in time, tends to be used in the analysis of active empirical regimes. If this quotient is less than 1, the existence of unregulated rivalries may be expected and, therefore, the resource is at risk of over-exploitation. In the opposite case, a situation of over-regulation prevails, which may also pose problems, above all on the level of the economic modes of exploitation of the resource (lack of allocative efficiency). In the empirical world, regimes can often be observed that are characterized by an excessively weak absolute extent. This is due to the fact that in the majority of cases the regulation of use behaviours only emerges as a reactive measure and very often when it is too late, i.e. after a particular use has developed to a point at which it represents a serious threat to

the reproductive capacity of the resource (e.g. CO2 immissions and climate change).

The criterion of coherence is based on the content and connection of the regulations established by the regime. It presupposes, firstly, that the definition of individual use rights, created by the public policies and/or property rights, does not exceed the global quota of the goods and services considered extractable without putting the reproductive capacity of the stock at risk.[25] Incoherencies between these regulations will be more likely to emerge as their number increases (i.e. elevated absolute extent). Such incoherencies may be due to regulations originating in the regulatory system and/or public policies or the connection between the two. Thus, we make a distinction between three types of coherences/incoherencies:

- The *internal coherence of the regulatory system* concerns the degree of clarity of the definition of the property titles or the use rights arising from them. While property rights are generally clearly defined for resources such as water or soil, they are far less clearly defined in the case of resources considered "ownerless property" from a legal point of view and in the case of resources that do not belong to the category of "material objects" according to the Civil Code, such as landscape, biodiversity or air. For example, incoherencies in the regulatory system may originate from the fact that there are more property titles or use rights for a single resource or a single good or service than resource units available or extractable in accordance with the definition of the global maximum quota. Such situations regularly exist in the case of the resource air (e.g. unlimited use rights assigned with vehicle licensing certificates) or the resource water (e.g. the unregulated free pumping of water from the water table for private bore holes).
- The *internal coherence of the policy design* concerns the coordination between policies governing the use and protection of natural re-

[25] In the sense of layer 2 in Figure 6.

sources. In the 1990s,[26] this was frequently very weak and sometimes even non-existent (e.g. the contradiction between the energy policy and the policy for the liberalization of the electricity market). Conversely, contradictions within the same policy – for example, between the problem definition, the causal hypotheses adopted, the choice of target groups, the definition of intervention instruments, the capacity for action of the political-administrative arrangement etc. – are more rare. Incoherent policy designs normally produce regulations that are incompatible with each other in relation to the different goods and services.

- *External coherence* concerns the mode of connection between the two components of a regime. It is expressed particularly through the correspondence between the target groups of the policy design and the holders of rights in accordance with the regulatory system. This correspondence is lacking when policies address target groups that do not have use rights and whose eventual changes in behaviour do not have any real effect on the actual uses of the resource. Other external incoherencies consist in the relatively common case whereby policies simply do not have sufficient coercive power to actually restrict the use rights of the users of a resource. An example of this is the incapacity to impose the minimum flow rates stipulated in the legislation on the protection of water (institutional regime for water) on the holders of dam concessions. Another example is the capacity of land owners to resist the implementation of zoning in the context of landuse planning (institutional regime for land and soil). Empirical research shows that a good indicator of the external incoherence of a regime is the "judicialization" of the implementation of the policy design [Rothmayr 2000, Nahrath 2005], and in the central role played by the jurisprudence of the courts in connecting the two components of the regime.

[26] See section 1.

Thus, the identification of gaps or incoherencies in a regime often helps to explain the empirically observed phenomena associated with over-exploitation.

4.3 Typology of regimes and their repercussions for sustainable development

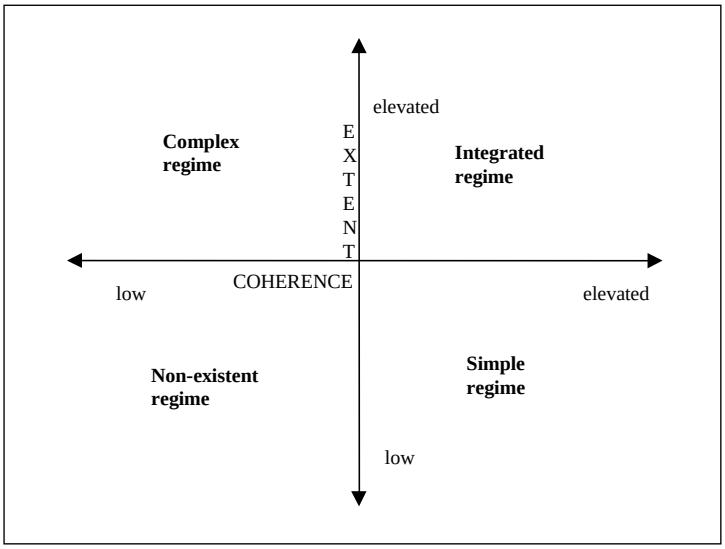
As stated above, the two key dimensions of extent and coherence enable an initial relatively simple typology of institutional regimes to be defined and hypotheses concerning the existence of possible links between their characteristics, as well as their supposedly variable contribution to the sustainable management of a resource to be established.

Figure 11 identifies the four main types of regime, which we describe as follows:

• *Non-existent regime:* Situation whereby the resource does not have any kind of property right associated with it or any kind of regulation of any of its goods and services by any kind of policy. Such a situation prevails, for example, when the need to regulate a resource has not been politically acknowledged despite the fact that the resource is subject to a range of exploitation. The empirical identification of situations involving non-existent regimes is only possible through the screening of institutional regimes for very long periods. Non-existent regimes may be encountered, for example, in the area of the resource air or landscape during the periods preceding the introduction of the legislation to counteract atmospheric pollution or prior to the constitutional recognition in 1962 of the need to protect the landscape.[27]

[27] Swiss Federal Constitution of 18 April 1999 (RS 101) (preamble and Art. 73).

Figure 11
The four main types of institutional natural resource regime



Source: (*inter alia*) Knoepfel *et al.* [2001:38].

- *Simple regime:* Situation whereby a limited number of goods and services (lower than the number of goods and services actually used) are regulated in a coherent way; the coherence of the regime results specifically from the low number of regulations in force and, hence, the low risk of contradiction between them. Such a situation can arise, for example, following an initial effort to regulate a resource by attempting to coordinate the uses of the resource that have led to rivalries between actor-users. This initial form of regulation may consist, for example, in the adoption of initial policies creating de facto use rights (initial policies for the prevention of air pollution) or, conversely, in-

volve the creation of an initial body of property rights (creation of the Swiss federal civil law in the early 20th century) independent of the existence of any policies. Such a regime may equally be the result of the "disintegration" of a previously complex or integrated regime. Moreover, in many cases, the raison d'être of such regimes is not the protection of the resource, but instead, as shown in section 2, that of guaranteeing access to the resource in the long term with a view to its economic exploitation or to the amortization of the operating installations required within a concession regime.

- *Complex regime:* Situation whereby the majority of the goods and services actually used are regulated, but in a way that is incoherent in part. This situation corresponds to most of the late 20th century regimes in Switzerland due to the extensive development of sectoral use and protection policies from the 1950s which are largely uncoordinated. Such a regime may also be the result of the disintegration of a previously integrated regime. Unlike simple regimes, according to the empirical data available, complex regimes are essentially the outcome of a political mobilization that aims to deal with problems surrounding resource rivalry and reproduction, the resolution of which, it is assumed, lies in the introduction of more regulations governing the goods and services of the resource in question. These regimes all involve more or less advanced attempts to formulate quotas by use sector, at least at the level of the goods and/or services regulated. From the perspective of resource economics, these regimes are characterized, however, by flawed mechanisms for the coordination of global quotas with the individual quotas (by use sector).
- *Integrated regime:* Situation whereby all of the goods and services produced by a resource and actually used are regulated in a coherent way. According to our research findings, such regimes remain very rare in the early 21st century. Examples in Switzerland may be found in the areas of landscape [Rodewald *et al.*

2005: 347 ff.; Gerber 2005: 374 ff.], forest [Bisang and Schenkel 2003: 198 ff.] and water (in the course of being integrated [Reynard and Mauch 2003]). Such regimes are found, in particular, where resources are largely in public ownership (e.g. forests) or under the control of a powerful collective actor (e.g. self governing CPR institutions [Ostrom 1990] like a Bourgeoisie or an Allmende association, or nature conservation organization such as Pro Natura).

The main hypothesis of the INRR concept is based on this typology. It presupposes the existence of a causal relationship between, on the one hand, the regime type (i.e. its extent and coherence) and its regulatory capacity, and, on the other, the sustainability of the uses arising from the regime's resources as well as status of the resulting reproductive capacity of the resource system. More concretely, *the closer a resource situation moves towards an integrated regime, the greater the likelihood of creating sustainable use conditions for the resource*. Conversely, *the less developed the regime is, i.e. the less elevated its coherence and extent (in particular relative), the greater the risks of over-exploitation of the resource*. The validity of this research hypothesis has been largely confirmed by the empirical research carried out in this area up to now.[28]

[28] For a synthesis of these studies, cf. Knoepfel, Kissling-Naef and Varone [2003].

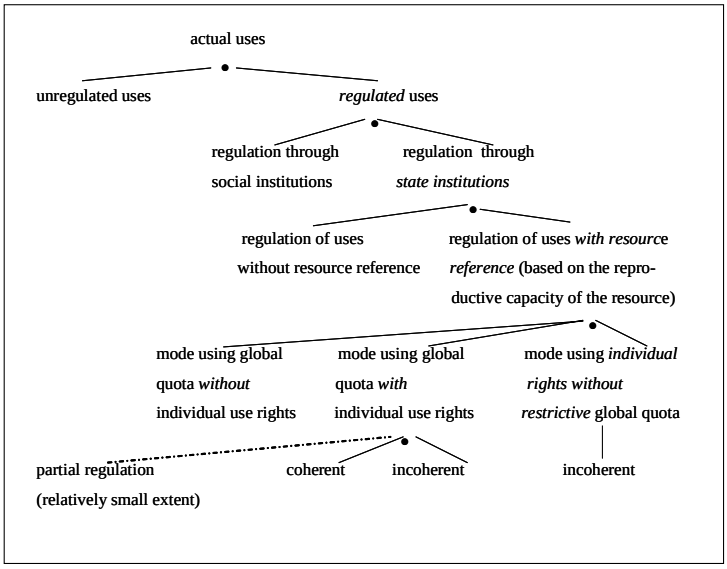
5 Empirical Applications

The uses or empirical/practical applications of the institutional regime concept may be both *scientific* (analytical) and *normative* (prescriptive) in nature. Thus we will present two applications of the concept in the remaining section of this chapter. The first is a guide for carrying out an analysis of the existing empirical regulation of the uses of a resource from the perspective of institutional regimes. The second, more normative one, proposes a usable framework for the development of (new) institutional regimes based on the more sustainable management of natural resources.

5.1 Applications of the INRR concept to the analysis of the empirical regulation of situations involving the exploitation of natural resources

The model shown in Figure 12 constitutes the chronological process of the implementation of strategic choices in the context of the emergence of a public intervention measure leading to the adoption of an institutional regime which regulates the uses of a given resource.

Figure 12
Guide for the analysis of existing regulations from the perspective of institutional regimes



The process proposed here is based on an empirical analysis of the actual uses of the resource, with a distinction being made between the unregulated ("unchecked") and regulated use situations. The researcher then identifies the uses regulated by social institutions (customary, associative, market-based etc.) and the uses regulated by institutional rules prescribed by a public authority. In the latter case, attention is then focused on the distinction between the regulations that refer to a resource-based framework and those that do not refer to a global quota. The latter involves the regulations relating to property, disposal and use rights stipulated in, for example, the Civil Code, which guarantee to their holders rights of use to the goods and/or services of the resources,

which are defined in absolute and inflexible terms as though the resource in question were any kind of material object. Thus, the researcher distinguishes between these rights, which have no "resource-based connotation", and use regulations that refer explicitly to a resource framework and define the use rights as a function of the reproductive capacity of the resource in question.

Amongst the regulations with a resource-based reference, the research may distinguish, in empirical reality, three different modes of formulation of such regulations. The first mode consists in the definition of quotas for global extractions that are not extended systematically and restrictively to individual use rights. The protection of the resource air illustrates well such a situation in that the global quotas defined by law in the form of ambient air quality standards (Swiss Federal Law on the Protection of the Environment of 7 October 1983) are not systematically translated into legally binding restrictions in the form of individual emissions when the quality standards are exceeded.[29] In such cases, the immission limit value will act as an indicative value rather than restrictive value. The regulatory modes governing such situations tend to be incoherent in nature.

Conversely, we may find situations in which individual use rights are defined independently of the definition of a global quota. Such conceptions are based on the idea that individual quotas may be regulated in a way that ensures their combined use remains, even in extreme cases, within the limits of sustainability for the use in question. The system of (daily) fishing licenses, and, more worryingly, the system of the unlimited allocation of vehicle licensing certificates, which is independent of any definition of a global quota for registrations that would make it possible to protect the air's auto-reproductive capacity, constitute two examples of this situation. Here too, the modes of regulation involved tend to be incoherent.

[29] Despite a provision contained in the Swiss Ordinance on Air Pollution Control of 16 December 1985 which stipulates a systematic adaptation of this kind by the cantons.

Between these two extreme cases, we find the mode of regulation most able to provide an institutional guarantee of the sustainable management of natural resources. It consists of global quotas and individual use rights and is equipped with a mechanism for creating coherence between the two types of quotas, which is indispensable to the emergence of an integrated regime. It is, however, also possible to find incoherent modes of regulation here when, as seen in the example given in section 3, individual quotas are defined, the sum of which exceeds the global quota. Again, such situations may exist in the context of the resource air when the regulations define immission and emission limit values independently of the number of pollutant sources. The coordination of a global quota with all of the individual use rights (which corresponds to a situation of integrated institutional regimes) may only be established if the number of regulated uses corresponds to the number of actual uses in the area in question.

It should be noted that the empirical validity of the INRR conceptual framework can be tested via the process described in figure 12. Its application highlights the existent or non-existent relationships between the characteristics of the regime, the reproductive capacity of the resource, and the regime's effects on the actual uses of the resource. Up to now, this test, which has been implemented by our team over the past six years with the help of numerous local case studies, has revealed an explanatory link that fulfils the key dimensions of the institutional resource regimes concept, both in diachronic studies (i.e. historical screening) and synchronic studies (i.e. detailed examinations of the phases of regime change and their concrete impacts on the management of resources).

5.2 The normative use of the concept of institutional regimes as a platform for the development of (new) institutional regulations aimed at the more sustainable management of natural resources

In this final section, we describe in broad and prescriptive terms the seven decisional stages necessary for the creation of an integrated institutional regime for a resource. Each of these stages is based on important political choices, of which the actors involved must be fully aware. This requires awareness-raising and participation processes in the form of, for example, sustainability processes within Agenda 21 projects. Table 7 presents these different stages in a general form.

Table 7
The seven stages of the decision-making process in the creation of an integrated institutional regime for a given resource

1 Political construction of the resource
• Political definition of the problem (scarcity, identification of rivalries between the different uses etc.).
• Identification of the boundary relevant to the management of the resource.
• Formulation of a causal hypothesis: identification of actor-users.
• Inventorization of existing use rights.
2 Political definition of the (annual) quantity of resource units available
• *Scientific-political consensus on the volume currently available for extraction.*
• Political decision concerning measures enabling the artificial increase/decrease of this quantity (extension of boundary, etc.).
• Definition of global quota of resource units authorized for withdrawal/extraction.
3 Evaluation of the legal scope of the definition of the global quota
• Coercive quota
• Indicative quota
• Reference framework in the event of conflicts (to be applied by the courts, for example).

4 Decision concerning the modes of "translation" of the global quota into individual quotas

- Through partial global quotas (for example, types of activities or types of territory etc.).
- Directly from the global quota to individual use rights.

5 Decisions concerning the modes of modification of use rights

- Modification of civil law or ownership rights.
- Changes in public law (limitation of ownership etc.).
- Introduction of flexibility clauses (variable use rights according to the definition (variable in time) of the global quota).

- Weighting of the desirable relationship between social, economic and ecological sustainability (equal weighting, in accordance with the Federal Swiss Constitution).
- Political choices necessary to modify use rights in accordance with the postulates that concretize these three dimensions of sustainability by area.

6 Decision concerning the definition of new use rights (in accordance with the principles decided under 5)

- Definition of eligible actor-users per good and service.
- Degree of exclusivity of rights.
- Specific flexibility clauses.
- Exchangeability, transferability.
- Spatial or temporal limitation (boundaries).
- Etc.

7 Institutionalization of monitoring

- Monitoring of the reproductive capacity of the resource in question over time (so as to evaluate the quality of the global quota definition and possibly adjust it).
- Monitoring of the actual evolution of the *global quota* (so as to evaluate or possibly adjust the definition of individual quotas).
- Monitoring of the *actual behaviour of actor users* in light of individual quotas (so as to evaluate the capacity of the individual quotas to actually steer the behaviour of actor users).

These seven stages in the decision-making process are explained in detail in the preceding chapters, thus we will not explain the table in detail here. Every reader, practitioner or academic can easily find examples corresponding to one or other of these stages in their professional experience. Of course, only the future will show us the scope and acuity of the real problems involved in the application of such integrated regulations, problems that reside in the regulatory system founded on the guarantee of private and/or exclusive property which is strongly rooted in political and legal institutions and in Swiss political mores [Aubin, Nahrath and Varone 2004]. Indeed, the highlighting of this dimension is one of the main contributions of this analytical framework. It should nevertheless be noted that this concept, which is simple and obvious to all of those concerned with sustainable development, has already met with a certain level of response, albeit still very abstract, for example in the strategy of the Swiss Office for the Environment, Forests and Landscape.[30] Similarly, the European "Euwareness" project has shown that the European Water Framework Directive of 23 October 2000 (2000/60/EU) heads in the same direction as the ideas discussed here on the subject of the necessary integration of institutional regimes [Aubin and Varone 2004]. Finally, the processes for the regional planning of forests currently under way in Switzerland also show astonishing similarities with our concept of institutional regimes. As showed elsewhere [Knoepfel 2005], there is moreover a clear interest in its analogous application to the area of local Agenda 21 sustainable development processes currently under way (summer 2005) in over 130 Swiss municipalities [DuPasquier *et al.* 2003].

[30] See OFEFP [2005].

6 By way of conclusion …

This last application clearly shows that the analytical framework of institutional regimes for natural resources is not solely a conceptual analytical tool with dimensions likely to influence the sustainability of a resource or the social, ecological and economic sustainability relative to its use. The following chapters show that this concept is also a potentially relevant political-administrative management tool which will make it possible to improve the efficacy of the regulations and behaviours of the actor-users of natural resources from the perspective of increasing sustainability. If taken seriously – as made possible by the concept of institutional regimes – the latter is far from merely being a new intellectual fad enabling dominant social groups to better relativize the requirements of environmental protection which today are often considered as inflated.[31] On the contrary, when applied to natural resources, the concept of institutional regimes makes it possible to implement some key elements of the constitutional principle of sustainable development in the form of relatively precise actions. Of course, they will need to be described in greater detail in the future in the context of action research within pilot projects. The concept lends itself to areas as wide-ranging as future natural regional parks [Gerber 2004; Gerber 2005; Oppizzi 2003], the battle against atmospheric pollution in urban regions [Mariéthoz and Savary 2004], the regional planning processes for forests in accordance with Article 18 of the Ordinance on Forests of 30 November 1992 (RS 921.01), climate policy (already very advanced implementation of CO_2 regimes at European level in accordance with Directive 2003/87/EU of 13 October 2003), the truly effective battle against urban sprawl and the waste of land [ARE 2005],

[31] These anti-ecological ideas were introduced into the Swiss political agenda at the beginning of this century by political parties such as the Swiss People's Party (*Union démocratique du centre*) and the Radical Democratic Party (Parti radical-démocratique) which see their beliefs vindicated by the considerable decline in interest in environmental issues demonstrated by surveys on the population's political priorities.

and the area of water management, in particular in countries prone to increasingly extended periods of drought[32].

Although the action area retained for the development of the concept of institutional resource regimes is primarily that of *common pool resources*, which include natural resources, the concept should also prove its worth in the management of all kinds of non-natural (i.e. artificial and intangible) resources such as cultural, social, human, and institutional resources, which are becoming increasingly important in a society engaged in a process of dematerialization. If, as is the case with natural resources, we exploit these common pool resources (or artificial and intangible resources) in an "unchecked" manner, allowing actor-users uncontrolled appropriation of the goods and services produced by them, we risk finding ourselves faced with situations of over-exploitation as a result of the attribution of use rights to actors who behave primarily as predators rather than as reasonable managers of these resources. Such a situation of over-exploitation of common pool resources risks ultimately leading to violent social struggles, the waste of resources and their associated goods and services and, finally, to a process of destruction of these resources which would probably exceed even the pessimistic prognosis formulated in 1968 by Hardin in his famous article "The tragedy of the commons" [Hardin 1968].

[32] Cf. on this point the example of Spain: Costejà *et al.* [2004a]; Costejà *et al.* [2004b].

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