

Knowledge matters: Institutional Frameworks to Govern the Provision of Global Public Goods

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1 Introduction

The provision of Global Public Goods (GPG)¹ has been extensively discussed in the recent literature. It has been the object of recent theoretical advances and has increasingly entered political debates both at the UN and at the EU levels. This paper focuses on the institutional frameworks relevant to make decision about the provision of these goods. This particular focus serves a double goal, practical and analytical. First, lack of knowledge on solutions and collective preferences is a serious practical challenge in any problem of global public goods provision. We therefore identify relevant institutional frameworks aimed at generating knowledge both to help citizens to build “enlightened” preferences in the matter and to provide decision makers with effective solutions to be implemented to provide these goods. Second, this particular case provides an important occasion to contribute to the development of a better analytical framework for the study of collective decision-making.

Global Governance deals essentially with the provision of GPG (Thoyer, 2007). It is characterized by several challenges. First, there is no government as a key actor to provide or to organize the provision of these goods and services. In addition, a complex web of non-state actors together with national states provides these goods and related services. Multilevel and international coordination and cooperations are needed to ensure their efficient provision. Second, there is a lack of knowledge on the actual needs and solutions. First, needs are to a large extent unknown. This is not only linked to a revelation problem as in traditional public good provision problems (**Ref). This is due to the fact that most citizens and economic agents do not have an explicit preference for goods as “conceptual” as global biodiversity, global public health, peace, global economic security etc.; in particular because it is complex to assess how they impact on their individual situation. Second, the solutions to provide these goods are to a large extent unknown. This is due to a bounded knowledge in the scientific understanding of the problems, in the design and implementation of relevant institutional and organizational solutions, as well as in the lacking diffusion of the existing knowledge. This is also because the provisions of these goods are inter-related and partly conflicting (e.g.

¹ Global public goods are characterized by the non-rivalry in their consumption and the non-excludability of potential users of a good of global scale. They cover a broad range of fundamental goods and services. The problem of the threatened world climate through greenhouse gas emissions is expected to affect all inhabitants of the world directly or indirectly. Turned positively, all will benefit from the use of a stable climate, which is non-rival by nature. The same holds for a rich biodiversity on the globe (global biodiversity). Potentially all citizens benefit of this guarantee of long term adaptability of the earth’s eco-systems to evolving conditions. Knowledge on specific species can be privatized, but is non-rival in its essence. Other examples for GPGs include public health, peace, and economic security (Kaul et al. 2003; Kaul et al. 1999).

development and biodiversity), leading to conflicts of interests that might hinder distribution of knowledge.

Governance mechanisms are needed to overcome these problems. These include the conventional rule setting by nation states, multi-lateral agreements and international confederations. Governance mechanisms can also be much less structured and more spontaneous such as international movements such as the World Social Forum. What seems necessary are governance principles not only ensuring consistency between the preferences of the citizens and the efficient provision of GPG, but also overcoming the knowledge gap necessary to build preferences and imagine workable solutions.²

In essence, this paper seeks to analyze on a new-institutional economic foundation the mechanisms by which certain issues can be recognized by global citizens (and decision makers) as of common concern³. We seek to better understand how alternative institutional solutions are efficient in generating knowledge and in ensuring its distribution to make sure that well-informed citizens could make collective decisions. This implies that citizens have to recognize their interdependencies and their dependence on the community to address certain issues. They then have to assess the value of the related “goods” in the hierarchy of their individual preferences. The costs — i.e. the resources to be dedicated to the production of these goods — have also to be assessed, in particular on an individual basis. Then mechanisms of aggregation are needed to compare costs and benefits both at a collective level — to make efficient collective choices — and at an individual level — to check the individual desirability of the alternative goods given the possible solutions to provide them. Of course the later strongly depends upon the institutional solutions chosen to provide the good. These various operations do not consist only in revealing and aggregating individual preferences and assessment. In a world of bounded rationality, all of them are depending upon the production of knowledge and upon its distribution to the citizens and to the decisions makers; otherwise

² For instance, democratic deliberation can generate more efficient outcomes than conventional (i.e. “command and control”) approaches because it allows taking into account the progress of knowledge and the evolution of the preferences of the actors

Our analysis shows the necessity to broaden the categories of traditional governance mechanisms. In the context of global governance, the existing forms of vertical accountability between citizens and the states legitimized by representative elections suffer from a lack both of efficiency (due to the high transaction costs linked to the size and the heterogeneity of the communities involved) and political legitimacy (due a lack of real accountability between decision makers and the citizens and due to the fuzzy assignment of prerogatives among decision makers). What seems necessary for legitimate and efficient governance of global public goods is the elaboration of more reflexive forms of governance that allow for mutual adjustment between stakeholders and decision makers, such as in deliberative spaces in international institutions, but also debates and transactions among various forms of state and non-state actors.

This claim has repeatedly been voiced within the debates on participatory governance in domestic, regional and local contexts (e.g. Fiorino 1990, Renn et al. 1995). Numerous approaches have shown the applicability of deliberative formats to solve governance processes with the inclusion of various stakeholder or citizen groups (Niemeyer and Spash 2001, O'Neill 2002, 2003). Examples include planning cells, citizen juries (Asselt and Rijkens-Klomp 2002) or consensus conferences (Joss and Durant 1995). As summarized by Mayer (1997), these participatory procedures not only diffuse information, allow for consultation, and support sharing of anticipation of the future, they also support the coordination of different forms and fields of knowledge, and the co-production of solutions, and social learning. While the existing literature has shown that deliberative approaches are particularly strong in integrating various bodies and forms of knowledge, concerns have been raised because of their limited legitimacy. The need for direct interaction restricts the number of individuals to be involved. Representation of different stakeholder groups and their respective knowledge and interests is possible, but the representation of larger shares of the population cannot be warranted by these procedures. What needs to be further explored, however, is whether and how far deliberative governance approaches can play a role in the international processes to provide global public goods.

³ We deal in this paper essentially with the contribution of new institutional economics to knowledge generation in the field of global environmental governance. As has been argued elsewhere, new institutional economics has made important contributions to the agenda of ecological economics and as such our paper wants also to contribute to this evolving research agenda. As shown by Paavola and Adger, three contributions of new institutional economics are especially relevant for ecological economics (Paavola and Adger, 2003). First, the conceptualization of environmental problems as key instances of interdependence (the choices of one agent influencing that of another) and not just as problem of externalities between independent agents. Second, the importance of analyzing policy implementation in the light of compatibility between governance solutions and patterns of interdependence as well as the problem of transaction costs. And third, the institutional approach suggests that more attention ought to be given to processes and procedures in environmental decision making in order to guarantee adequate learning and fair representation of affected parties and legitimacy of environmental decisions. This last contribution – the focus on decision making processes – has not received a systematic treatment as yet and it is here that our paper attempts to break new ground

neither individual preferences, nor individual and collective benefits/costs assessments can be made. As mentioned above, this knowledge concerns the nature of the good — to what extent resources as stability of the climate or biodiversity are of value for human beings, are public goods, are global rather than local PG? —, the technical solutions to provide them — which include an economic assessment of the costs and constraints such as irreversibilities and risks of provision, and also analysis of the distribution of these costs —, and also the interdependences among these goods — indeed, in a world of scarcity there is competition among the various public goods. We therefore seek to better understand how alternative institutional solutions are efficient in generating knowledge and on ensuring its distribution to make sure that well-informed citizens could take collective decisions.

The paper is structured as follows. We first motivate the paper and explain why it is relevant to assess the performances in terms of knowledge generation of alternative collective decision mechanisms aimed at establishing choices in matter of Global Public Good. We do this from a theoretical perspective, which leads us to justify the assumptions we are relying on (section 2). We then develop an analytical framework aimed at establishing a link between processes of collective decision-making (in matter of GPG) and performance in terms of knowledge generation. This leads us to highlight the various trade-offs among alternatives in matter of governance. We point out in particular that the various processes of decision making — which can be chosen for other reasons than their performance in terms of knowledge generation — have contrasted abilities to generate knowledge in general, and also contrasted capabilities to produce different categories of knowledge relevant for different purposes (we contrast in particular the production of knowledge aimed at delimiting and weighing issues and knowledge about socio-technical solutions to address these issues; section 3). Our framework is then used in a normative way to identify the institutional solutions that will best ensure the production of the various types of knowledge needed to ensure efficient provision of GPG (section 4). In both sections 3 and 4 we develop our analysis and rely on real world experience in matter of environmental governance to show how our framework can be operationalized, both to be tested, and to result in real world recommendations. Indeed, our aim is not only to provide an additional interpretative framework to understand what is going on today in matter of global governance. We would like to contribute to the on-going debates on the provision of more consistent institutional framework in the context of increasing needs for global regulation and for more effective provision of global public goods. We recognize that knowledge generation is not the only criteria according to which choices in matter of governance have to be made. We wish however to push further the idea that knowledge matters and that institutional design should also be thought in function of cognitive performances.

2 Scope of the problem and basic assumptions

In this paper, we are interested in the global governance of global public goods. By global governance, we mean any process of rule making and implementation on local, national, regional and global levels that address global concerns⁴. As stated in the introduction, the key governance problem in the provision of global public goods is the lack of clear-cut knowledge on collective preferences and solutions. This “cognitive” problem however covers a diverse set of cases and, before discussing the contribution of alternative governance principles to solving this problem, it is important to specify our analytical framework.

⁴ For current debates on the definition in global governance see Young 1997; Haas 2004; Dingwerth and Pattberg 2006. For the discussion on the particular role of non-state actors as a central characteristic of global governance as opposed to state-centred politics see Ronit and Schneider 1999; Reinicke and Deng 2000; Hall and Biersteker 2002; Scholte 2002; Biermann and Bauer 2005;

Public goods are goods of “common concern”, called more appropriately “collective goods”. They are characterized by the properties of non-rivalry in consumption of the good – the use by one does not diminish the possible use by another – and non-excludability – it is costly and sometimes impossible to exclude a user from the access or the use of the good. They include both pure public goods such as collective security and information, which have both properties (non-rivalry and non-excludability) and other types of public goods, which have only one of these properties: common pool resources such as land, water (etc.) are rival and non-excludable, and club goods such as encrypted TV programs or intellectual property rights are non-rival and excludable. However, it is important to qualify this conventional approach. Indeed, the properties of rivalry and excludability are not absolute. They strongly depend upon processes of social construction. For instance, rivalry in consumption of a good is directly related to the density of the population (Platteau, 2000, pp. 336-337) and “exclusion” is “artificially” and socially constructed (Kaul *et al.* 2003, pp. 81-87)⁵. In this broad approach, economics has to be combined with political science and ecology amongst others. This is what we try to manage in this paper, while attempting to provide a consistent framework that is detailed below.

We first point out that we assume a world made of individuals who have their own ends, but who recognize that they belong to communities in which two types of social relationships are built. On the one hand, exchange is at the basis of many social interactions by which agents align their individual interest through bargaining ending by *quid pro quo* transactions. On the other hand, the logic of gift (without *quid pro quo* compensation) is at the basis of social interaction by which agents align their interest by defining a common interest encompassing and surpassing individual preferences. The definition of this “collective interest” is under the influence of players who might push their own interest, but who have nevertheless to take into account the interest of the other members of the concerned community (2.1). These two logics of social interactions generate different types of governance mechanisms that often interact and are hybridized in global governance. We then point out why, in the context of the provision of GPG, bounded rationality (2.2) and the global context (2.3) combine to call for the generation of new knowledge.

The considerations of this section will provide the foundations for the comparative analysis of various possible governance schemes that could be implemented to make decision in matter of GPG provision in the light of their ability to generate the appropriate knowledge in an efficient way. Our analysis of alternative governance schemes will be based on the recognition of the absence of an established global community. The various components of our framework presented in this section, will be combined in the next section 3 to result in a typology of alternative governance mechanisms available to manage the provision of GPG.

2.1 Individuals and their motivations

To analyze the alternative institutional arrangements for the provision of global public goods, we rely on an analytical framework that derives from New-Institutional Economics. We consider the global society as a collection of individuals already embedded in social structures, but which are characterized by individual preferences (while they can be collectively built). These individuals have a bounded rationality in the sense of Simon (1976, 1987), and more

⁵ Examples of rival goods made (partially) exclusive are the atmosphere (through the system of air pollution permits) and fish stocks (through fishing quotas). Rival goods made non-exclusive are public parks and nature reserves. Non rival goods that are made exclusive (hence creating a club good) are knowledge that is kept secret (such as the deep sea biodiversity information generated by the oil drilling companies). For a discussion on this extended concept of public goods, see Kaul *et al.* 1999.

precisely a procedural rationality (Simon 1978). Individuals and collectivities are nevertheless repositories of knowledge. Individuals know how to solve problems (including learning to solve problems that are unknown to them, which is the idea behind the notion of procedural rationality). They also have a social capability to interact with other individuals that can help them to solve problems.⁶ The unit of analysis is therefore a collection of individuals, who are both stakeholders⁷ and knowledge-holders.⁸

Each of our individuals has his or her own set of preferences and his or her own ranking among them, depending of his or her situation in the society, history, beliefs, etc. These preferences are ordinal and subjective. They therefore cannot be weighted and aggregated to result in a collective preference function (see, May 1954; Savage 1954; Arrow 1986; Friedman 1953; Sen 1995). In addition the system of preference of an individual is incomplete and therefore instable. Since his rationality is bounded, he can discover new options and therefore revise his whole system of preferences (See Simon 1957, 1983, 1986; Selten 1990).

Self-interested individuals are before all interested by the realization of their ends (according to their system of preferences). However, they recognize that this realization is depending upon a successful coordination with the other individuals in the society. Individuals do not spontaneously recognize, however, themselves as being member of a local, national or global society that will encompass either all the living individuals, or even all the individuals living in a common territory, or belonging to the same ethnic group, etc. To be consistent with the idea that individuals have a bounded rationality, idiosyncratic hierarchies of preferences and specific beliefs, it must be recognized that the concept of society is subjective and has little chance to be implemented consistently in the set of preferences of all individuals. To put it another way, all the individuals do not have the same “vision” of what the society is, and they do not all share the idea that humankind per se is a society; which will raise the issue of the definition of problems of “global” concern (see below). While we recognize this, we assume nevertheless that individuals are social beings. They recognize that they belong to collectivities. A collectivity has both an objective and a subjective aspect. It is characterized by the existence of common rules of behaviors that draw from the convergent beliefs of members that they share interests, which justify constraints to perform collective action. These collectivities can be qualified as communities to point out their “subjective” aspect, and its consequences⁹.

In any case, individuals recognize that the realization of their ends leads to interactions with the other members of their communities. These interactions can be based upon two alternative principles. The principles are those of trade and compensation vs. those of sharing and compromise. According to the first one, an individual accepts to renounce to something (from the benefit of a good to the one of a “right” and including making an effort) if and only if he

⁶ Thus, throughout this paper we rely on an implicit definition of knowledge, which is an ability to solve problems. While alternative definitions to knowledge could be proposed, we do not go further since our purpose is to propose a political economy of the knowledge generation process. We need to characterize the alternative processes rather than the alternative forms of knowledge.

⁷ The notion of stakeholder used in this paper differs from the original understanding of stakeholders of companies as developed by Freeman 1984; Clarkson 1995; Donaldson 1995.

⁸ Indeed knowledge is not a pure individual capability. Knowledge is both embodied in human capabilities (both in codified and tacit ways) and in social structures (organizations, institutions). The way individuals interact is a solution to many problems or allows building solutions. Development of knowledge refers therefore both to the development of individual capabilities to address problems and to the development of organizational and institutional capabilities.

⁹ In particular, individuals can belong to several communities that are therefore fuzzy sets (in the mathematical understanding). Communities may overlap.

is compensated by the provision of a good or service that balances his losses of satisfaction due to his renouncement. The second one states that individuals, while they recognize their individual ends, consider the community as a tool to reach these ends. They contribute to the realization of the ends of the other members of the community and (expect to) benefit in turn from their contribution to their own ends. To put it shortly, the first form refers to economics, the second to politics. Since individuals are confronted with a world of neither pure economic, nor pure political logics, they understand that the realization of their individual ends relies on both logics.¹⁰

This results in complex motivations. Individuals have both (what is usually qualified as) individualistic preferences — which are in our wording economic preferences linked to the logic of transactions — and collective preferences — which will be qualified in our analysis of political ones linked to the logic of sharing and compromise. Obviously these preferences are different from one individual to another, and are also balanced in a different way across individuals for different purposes. However, clearly the individuals we have in mind have complex motivations because they take into account at the same time their immediate interest — i.e. their individual wealth — and a broader collective interest — since they know that the wealth of the community/society impacts on their individual situation. To put it another way, individuals have both exclusive interests — they decide in function of their own situation — and inclusive interest — they take care of the impact of their actions/decisions on other stakeholders in the society and have also (individual) preferences for the society. Both types of interests can be dealt with within centralized or decentralized institutional systems.

2.2 Public goods and the problems raised by their definition and their provision in a world of bounded rationality

Among the problems that individuals have to solve, they identify in particular two categories of problems that, by definition, are collective. This is first the provision of an infrastructure to manage their interactions (from the language to market places and including the institutional framework in the sense of Coase [1991] and North [1990]). The second is methods to manage external effects¹¹. External effects occur when for some reason the use of an asset by one individual impacts (positively or negatively) on the utility of some non-users of that asset, while it is either technically impossible, or would be prohibitively costly, to confine the service of that asset to a peculiar person or group. What is qualified as a public good since Samuelson (1954, 1955, 1958)¹², is simply an extreme case of externality. A service is automatically provided to all, while this provision to all does not deprive anybody from any benefit of this service.

¹⁰ Our goal here is to clarify the drivers of individual social behaviors. The dominant vision is to contrast two faces in human psychology: selfishness and altruism. The first one refers to economics and leads to envision a society in which central coordination is useless (or should be fully neutral). The second one refers to ethic (and politic) and lead to consider the market at best as a useless mechanism; and most often as seeing it as a factor of destruction of altruism. This leads therefore to consider decentralized coordination mechanisms as inherently linked to selfish motivations and centralized mechanism linked to altruistic orientations. Market coordination understood as spontaneous and competitive coordination would therefore have to be compensated by political coordination which would be the only way to consider issues considered as “ethical” in the sense that it would guarantee that all interests (those of the weakest, but also those of the group) will be taken into account. Our analysis allows us to disentangle the logic of coordination (driven by individual interest vs. collective one) from the mechanism of coordination (which refers on how collective decisions are made), which is useful to understand the properties of alternative governance mechanisms and institutional architectures.

¹¹ In this paper, we precisely recognize that the production and distribution of knowledge is also a problem of collective concern. We therefore do not state that the provision of an infrastructure for interindividual interactions together with solutions to manage externalities are the only problems of collective concern even from a pure economic point of view.

¹² "The Pure Theory of Public Expenditure", 1954, REStat.

"Diagrammatic Exposition of a Theory of Public Expenditure", 1954, REStat.

"Aspects of Public Expenditure Theory", 1958, REStat.

As recognized even by Austrian economists such as Hayek (1976, vol. 3), the pure logic of decentralized trade fails to provide these goods because of the well-known problem of free riding that generate the “tragedy of the commons”. This does not mean that the provision of these goods should rely on an organization called the state. This means, however, that the provision of these goods should rely on coercion, which should apply to all the members of the community that will benefit from the good. *“If, (...) [each member of the society] knows that compulsion can be applied only if it is applied to all including himself, it will be rational for him to agree to be compelled, provided this compulsion is also applied to others. This will in many instances be the only way in which collective goods can be provided which are desired by all or at least by a large majority.”* (Hayek, 1976, vol. 3, p. 44). It has been well documented by Ostrom (1990) in particular that compulsion can emerge spontaneously at the local level because, in certain circumstances, local communities can control the behavior of their members due to the stability of groups, the repetition of interactions, the high cost of exclusion through ostracism and the easy diffusion of information on the behaviors of members that sustain reputation effects. Due to the spontaneity of these effects in small and stable groups, spontaneous cooperation emerges on the basis of these strong constraining mechanisms. However, as well demonstrated and argued in the North, Milgrom and Weingast (1990) model¹³, the larger the group, the more formal and institutionalized must the coercion mechanism be.¹⁴ In any case, collective goods raise the issue of organizing provision of a service available to all on the basis of mandatory contribution, (not of the provision by the state).

While the acceptance of a principle of coercion allows to gather the means to provide a public good, the remaining problem is to select among the many potential public goods those which will be actually provided (due to scarcity constraints) and how they should be produced. In a world of perfectly rational agents (in the sense of Savage, 1954) each individual has a complete and stable set of preferences. He is therefore able to value each potential public good, and a revelation scheme can be implemented by a benevolent and costless social planner to have the individual revealing their preferences in a way — their propensity to pay — that allows an aggregation of individual preferences.

In a world where agents do not have a perfect rationality, two problems occur. First, bounded rationality means that agents are unable to value according to a common currency their individual utility for each possible public goods, Even if they would be able to rank their preferences — which supposes they know the complete list of potential public goods —, a social planner would be unable to aggregate their preferences because the Condorcet-Arrow paradox of social choice would apply. Second, bounded rationality could result in agents ignoring the complete lists of potential public goods. In that case, it would be impossible for any social planner to decide the projects to be realized on the basis of individual wishes. In such a world, then, no solutions would be available to decide on a transaction/trade/compensation basis the amount and the type of public good to be produced. In addition, in a world of bounded rationality, the scope of the community concerned by the provision of a public good remains an open question. The very notion of public good comes

¹³ Which, by the way do not refer to the production of public good in general, but to the provision of a special public good : a contract enforcement mechanisms to allow the performance of a market.

¹⁴ This reasoning applies to Coase’s approach to the provision of public good. The lighthouse story shows indeed that as long as most ships benefiting from the service had to call at local harbours (because of the technology and because their port of registry was in the same regions than the lighthouses), it was easy to implement a relatively cheap mandatory contribution system based on private enforcement. However, with the globalization and the development of the sea traffic, it became increasingly costly to raise the fees for the use of the service and a more constraining way of guaranteeing contribution had to be implemented. Thus public provision substituted to private one because of the higher power of constraint (to contribute) of a state as compared to a private actor.

with the notion of community. There are two conditions for the existence of a public good. The members of a community should recognize themselves as members of a common community (whatever the purpose/nature and boundaries of the community). They have in addition to recognize that a given good is a public (or collective) one. The first condition leads each member to accept the legitimacy of a constraint put on him or her by the group. The second one legitimates the constraints that are actually implemented to provide a given good.

2.3 Public goods and the problems raised by their definition and their provision in a global context

This paper seeks to analyze the mechanisms by which the notion of a global community — i.e. a community encompassing all the (present and future) human beings — could emerge and how its members could recognize the existence of a public good at this level¹⁵ and agree on priorities and on ways to provide them. There are two main issues to be dealt with. First, agents have to recognize the existence of goods of common concern at the global level, which means that they recognize a global community. Since there is no established global community recognized as such by all its members, the qualification of a good as a GPG does not result from any agreement among all the human beings or from any process of aggregation of their will or consent. Some goods are claimed as being GPG by communities that, on the one hand, consider the externalities among existing communities, on the other hand may have strategies to promote their interests. Indeed, they can seek to benefit from the contribution of others in the provision of a good that benefit in priority to that community. They can also promote the production of the public good they prefer. One central consequence of this “subjective” nature of the so-called GPG, is that their qualification as global and the ranking of preferences in matter of GPG will always remain open to challenge.¹⁶ Second, agents have to establish a collective hierarchy of preferences about the identified GPG and between GPG and the alternative public (i.e. local public goods) and private goods; since in a world of scarcity there is a competition among the various goods that could potentially be provided. This second issue requests the understanding of two sets of intertwined questions. First, the relationships among (the alternative ways to provide) the various GPGs have to be understood, since if the provisions of these goods are not independent amongst each other (e.g. potential complementarities and/or substitutability's and/or hierarchization), it has to be dealt with in the establishment of the hierarchy of preferences. Second, the cost of production of the GPG, which are ends in competition with other ends, are also not independent of the establishment of the hierarchy of preferences. Agents have to know the costs (in terms of renouncement to the provision of alternative goods) of alternative ways to provide GPG, both to take into account production constraints and the possible interdependencies among GPGs.

Since we assume that our individuals do not have a perfect knowledge (bounded rationality), we see any agreement on the types of global public goods to be produced and on the way to do it as being not only a problem of revelation and aggregation of preferences, but as a problem of discovering issues and ways to deal with them. Individuals and communities,

¹⁵ Indeed many public goods are public goods for specific communities. They provide services that are worth to those who receive them. They are local public goods, which are usually defined either by social networks or by geography (which organize social networks or socio-political communities). The problems of the provision of public goods within these contexts are out of the scope of this paper and are addressed by a wide literature. See in particular Sandler (1992; 1997; 2006).

¹⁶ In what follows, we therefore assume that global public goods exist, which seems to us a sensible assumption since the ecological sustainability of the planet, for instance, is a condition of the survival of the human race, even if the exact definition of what counts as the GPG depends on its qualification by the community, the ranking of the preferences, etc.

before expressing preferences, have to discover the (global) issues and to figure out what could be the conditions (and therefore the costs) to address them. Put another way, while we recognize that the alignment of individual interests and the building of compromises is an issue for the provision of global public goods, we think that in addition the provision of these goods requires the development of knowledge to identify them, to understand the complex web of causal relationships that link the various global public goods, to discover how they can be delivered. Thus the issue we are focusing on is the generation of knowledge about the nature and the provision of global public goods.

The absence of an established global society reinforces the necessity to generate knowledge. Generating knowledge should allow benefiting from more information about the interdependencies among individual interests through the provision of goods. Thus, the more knowledge, the more inclusion of all individual interests in collective choices, and therefore the better recognition of the nature, the hierarchy and the efficient way to produce GPG. In turn, the identification of interdependencies should allow each individual to express more “informed” preferences since each has a better vision of the links between his or her own interest and the collective one. Thus the more knowledge, the more complete is the set of individual preferences¹⁷.

3 A model to analyze the “political economy” of knowledge generation

The focus of this paper is on the contribution of the alternative regimes of decision making to the generation of knowledge to govern the provision of global public goods. What is needed therefore is a framework for the assessment of alternative forms of decision making focusing on their ability to generate knowledge so as to (a) make more balanced choices thanks to a better knowledge of the stake-holder preferences, and (b) make more efficient choices thanks to a better knowledge of available solutions and of their conditions of implementation.

We presented in section 2 our basic assumptions. We need criteria to build a typology of alternative decision-making processes. Our aim is to remain realistic by being able to contrast actual decision/governance principles that are under debate, while we seek to remain parsimonious in not making excessively complex our analytical categories.

In section 3.1, we propose criteria for the efficiency and the quality of knowledge generation processes (section 3.1.1). In addition, we will categorize alternative processes of decision making (alternative governance regimes) in global governance (section 3.1.2).

3.1 A framework to compare alternative decision mechanisms from a knowledge creation perspective

3.1.1 Criteria for assessing knowledge generation processes

As pointed out in the synthesis by Foray [2004], knowledge is a good characterized by three main features. The first one is qualified as uncontrollability and means that knowledge is not for one purpose only. Most of the time the future uses of knowledge cannot be anticipated because it is “of general purpose”. Even if it has been designed by targeting a goal, different users can use a piece of knowledge in different ways. Second, knowledge is cumulative. New knowledge draws from the recombination of ideas and/or from the criticism of past ideas.

¹⁷ Thus the vision we have is consistent with the evolutionary epistemology of J. Campbell and the democratic experimentalism of C. Sabel. There is no way to reach an ideal state. We are always dealing with imperfect and incomplete solutions. More knowledge is better since it allows (even if it does not guarantee) to more relevantly take into account the more informed preferences of more individuals.

Third, knowledge is a non-rival good. From this vision we can highlight four dimensions that will enable us to assess the performance of an institutional arrangement in the generation of knowledge.

- i. First, knowledge generation can be evaluated on the basis of the adequacy of the resulting knowledge for the specific purposes of providing solutions to GPG-related problems. Adequacy can be understood as the degree to which knowledge allows actors to solve actual problems. It takes recourse to the notion of “saliency” as introduced by Mitchell et al. (2006, p. 15). It has been understood as a quality of knowledge that is perceived by actors as relevant for their decision-making.
- ii. Second, the ability of a process of knowledge generation to favor disclosure/revelation is essential since it encourages the production of new knowledge (by combination of uncontrollability and cumulateness). In that respect, for instance, the obligation to disclose publicly either in the scientific world or in the realm of industrial property (patents) can be considered as leading to efficiency since others can benefit from this knowledge.
- iii. Third, the speed of knowledge generation matters, since it levers the production of knowledge (due to cumulative effects) and allows therefore increasing the stock of available knowledge¹⁸.
- iv. Fourth, access to knowledge¹⁹ is essential once it has been produced as for any non-rival good. Thus the ability of a process of knowledge generation to make knowledge available for the wider number of potential users (and therefore its costs of access, which encompasses both the price of knowledge and the costs to be borne to use it: learning efforts, complementary investments, etc.) has to be considered.

These four criteria refer to potential benefits. An assessment should however consider the balance between costs and benefits. Two types of sources of costs differentiating the alternative decision making processes matter:

- v. First, there are the costs of the resources dedicated to the generation of knowledge. It should be considered in particular whether the process leads (or not) to duplicate efforts, and relies (or not) on the existing stock of knowledge.
- vi. Second, the costs of coordination among the parties involved in the process of generation should be taken into account.

Thus we will assess alternative ways to make decision on global public goods on the basis of six criteria, namely (i) the adequacy of the knowledge generated, (ii) their ability to favor disclosure and revelation (to maximize spillovers), (iii) to speed up the generation of knowledge, (iv) to favor access to knowledge, (v) to use efficiently the available cognitive resources, (vi) to reduce costs of coordination among those involved in the production of knowledge.

¹⁸ This dimension should however be qualified since the stock of knowledge is not totally accumulative. Indeed, new knowledge can depreciate old one. This is a problem in two cases. First, when knowledge is embodied in capital — like a computer or a tool, and also an organizational design —, it may lead to discard investments before they are really written off. Second, since the ability to memorize is bounded, new knowledge may lead to forget how some types of problems were solved; which might be a problem if these problems have to be solved again. Solutions are to be reinvented and the initial cost of development and those of experience are lost forever.

¹⁹ Accessibility is about enabling the transformation of knowledge into action (practical solving of problems). We therefore care about who does support the burden of translating the knowledge into practical solutions. If it is the producer, then the knowledge is accessible (and to a certain extent of good quality). If the user has to decode the knowledge, then it is of lower accessibility, quality, etc

3.1.2 *The Key Dimensions of Collective Decision Mechanisms*

A governance mechanism consists of a decision mechanism and of enforcement capabilities. Since we focus on knowledge generation we will focus on the properties of decision making only. Our typology of governance mechanisms relies on two classical dichotomies that have been extensively studied in the social sciences. First, we contrast centralized versus decentralized decision making mechanisms. In a national context, most governance issues are separated between local, regional and domestic levels, with particular advantages and disadvantages (Karahan et al. 2002). In global governance, this separation of centralized versus decentralized becomes even more faceted through the existence of multiple levels of governance (Bache and Flinders 2004). The second dichotomy spans between contract type mechanisms based on self-interested individuals (exclusive interests) *versus* mechanisms that are based on social and communitarian logics with individuals oriented towards a collective outcome (inclusive interest). We have discussed this dichotomy between actors' orientations in section 2.1., but it is also used elsewhere as shown for example in Fritz Scharpf's overview of actor-centered institutionalism (Scharpf 2000). However, as we will show in our discussion, this characterization of the possible decision making mechanisms should be broadened to include two other issues that are key in the GPG debate : the influence of the scope of the decision making process and the influence of alternative modes of accountability between decision makers and stakeholders. The first is important to consider because of the global character of the problems at hand, and the second because of the increasing role of non-state actors in the global arena (Bohman, 2004). According to us, the following four dimensions allow thus to contrast the principles according to which collective decision-making is/can be organized at the level of the "global society".

- a. The *scope* refers to the size of the community that is concerned by the resulting order/decision. More precisely it refers to the community which interests are (primary) taken into account when decisions are taken or when regulatory principles are decided. This community can tend to be global and the scope will be qualified as wide, or it can be local (and closed) and will then be qualified as narrow.²⁰
- b. The notion of *orientation* refers to the (primary) motivations of individuals (see section 2.1.) when interacting to make collective decisions and/or implement an order. Does the mechanism aim at dealing with individuals that consider before all their own individual interest (exclusive) or do they consider at the same time the "collective" interest (inclusive).²¹
- c. The notion of the *organization of the decision-making* refers to the explicit design of a collective decision making process. When this is not the case, collective decision simply results from the aggregation and spontaneous adjustment among individuals. In the first case, the relationships among individuals are organized because this increases the efficiency in managing interdependences. One can expect therefore a strong accountability of those involved in the decision making process because they are stakeholders and have clear goals (their own or delegated ones)²². On the other hand, interdependences can be

²⁰ Regulations organized by/within international environmental politics such as the climate treaties have a wide scope; while the regulations organized by neighbourhoods or local communities analyzed by Ostrom (1991) have a narrow scope. Likewise, global activism such as the initiatives organized under the World Social Forum are wide in their scope while local activism such as the one to be found within "not-in-my-backyard" protests (NIMBY) against nuclear power plants or garbage dump sites (Laws, 2003) can be qualified as narrow.

²¹ Collective bargaining between trade associations and unions or market self-regulation are examples of rule-making processes based on the idea that a collective order results from compromise among holders of exclusive interest. By contrast, many environmental non-governmental organizations or scientific communities are driven by the will to take decisions and build orders for the benefit of the whole humankind.

²² This is the case of representatives in modern constitutional democracies or within organized local communities, which are precisely organized to build and promote some ends such as joint forest management. In a similar vein, a referendum is also a way to "organize" collective decision-making

spontaneously managed. One can expect a weaker accountability of those who act, because their actual impact on decision is unclear or because the relationship between them and the stakeholders is uneasy to establish. Their actions result in facts and information, not in collective choices and organized knowledge²³.

- d. The notion of *delegation of the decision-making* refers to the fact that collective decision is centralized in the hands of a limited number of individuals, or is really decentralized in the sense that each individual is able to express voice and impact on decision. In the first case there is either explicit delegation of decision-making like in hierarchies and in constitutional states, or a kind of spontaneous delegation by which “leaders” are followed by the other members of a community (without any explicit delegation of any rights to make collective decision). In the second case, there is neither explicit nor implicit delegation of rights of decision of any kind and the decision remains decentralized in the hands of the members of the communities).²⁴

These four dimensions develop along continua — the scope can concern communities of any size from two-persons communities to the whole humankind, etc. — however in the following we will point out the main contrasts by distinguishing on a dichotomic basis the two extrema of each of them. It must be clear, however, that this is just a didactic purpose. When one considers actual decision-making mechanisms, one cannot contrast centralization and decentralization, for instance, but more centralized and more decentralized processes.

These four categories refer to contrasted tradeoffs in terms of benefits and costs:

- Along the *scope* dimension, one can contrast mechanisms that will have to manage more vs. less heterogeneity and will therefore result in higher vs. lower costs of decision making, while in contrast it will lead to solutions that will benefit more vs. less of possible economies of scale and scope, and of more consistency vs. less consistency (due to an appropriate management of interdependencies). A detailed analysis of these trade-offs can be found in Brousseau and Raynaud (2007).
- Along the *orientation* dimensions one contrast individual vs. collective welfare as a driver of decision making.
- Along the organization dimension we contrast mechanisms that guarantee clear responsibility and therefore accountability towards the principals of the decision makers who act as agents of the former and processes that, because they are organized, should, everything equal, be cheaper, faster and more conclusive (in the sense that decision are clearly made) to decision mechanisms that are less efficient when considering these criteria, while they could lead to more innovative decisions and more efficient adaptations (to heterogeneous and evolving needs) since they allow more freedom.
- The delegation dimension contrasts mechanisms that economize on agency costs to mechanisms that economize on duplication of efforts and allow specialization of decision makers.

²³ This is the case of consumers or activist movements who act on a decentralized basis and whose actions (for instance about complying or not to a principle/rule) result in de-facto decisions.

²⁴ Explicit delegation occurs in hierarchies and in constitutional states. Spontaneous delegation can be found in activist movements and transnational NGOs are seen as representatives of larger crowds in their activism against global diseases or climate change. No delegation occurs in self-governed management of natural resources in fisheries or irrigated farmland by communities of resource users (Balland and Platteau, 1996).

Table 1

A typology of 16 Governance Mechanism aimed at dealing with Global Governance Issues

Scope	Logic of Inter-individual Relationships	Organization of Relationships	Centralization of decision making	Nickname	Example of Decision Mechanisms	
Wide	Exclusive	Organized	Centralized	<i>Global Confederation</i>	<i>Pan-European Forestry Process (and WTO, EU Council)</i>	
			Decentralized	<i>International Referendum</i>	<i>Consultation on Material Transfer Agreements (MTA) in the World Federation of Cultivar Collection (and Consultation in the WSIS)</i>	
		Spontaneous	Centralized	<i>Global Self-Regulation</i>	<i>Forest Stewardship Council (FSC), Marine Stewardship Council, IBF</i>	
			Decentralized	<i>Global free market</i>	<i>Bio-prospection contract</i>	
	Inclusive	Organized	Centralized	<i>NGOs Coordination</i>	<i>International Union of Nature Conservation</i>	
			Decentralized	<i>Republic of Science</i>	<i>IPCC, DIVERSITAS, Earth System Science Partnership</i>	
		Spontaneous	Centralized	<i>Global Activism</i>	<i>World Social Forum, Greenpeace</i>	
			Decentralized	<i>Emotional Collective Action</i>	<i>Al Gore, Life Aid (Bob Geldof)</i>	
	Narrow	Exclusive	Organized	Centralized	<i>National Government</i>	<i>National Environmental Management Plans National Energetic Policy</i>
				Decentralized	<i>Local Direct Democracy</i>	<i>New York Referendum on Forest Water Sanitation</i>
Spontaneous			Centralized	<i>Local Self Regulation</i>	<i>Management of Water by Community of Farmers</i>	
			Decentralized	<i>Legal Activism</i>	<i>Lawsuits against Airports, Petitions, Boycott,</i>	
Inclusive		Organized	Centralized	<i>Service Providing Nonprofit Organizations</i>	<i>Bird Watchers Organization, Local Environmental Clubs Joint Forest Management</i>	
			Decentralized	<i>Communitarian management organizations</i>	<i>Communitarian management of Common Pool Resources</i>	
		Spontaneous	Centralized	<i>Local Activism</i>	<i>Honey-Bee Network (Das Gupta)</i>	
			Decentralized	<i>Neighborhood Action</i>	<i>Citizens Street Cleaning, Frogs Gathering</i>	

Our proposed way to describe alternative (*de facto*) decision mechanisms in matter of global governance allows us to contrast 16 essential modes of coordination. In table 1 we show how the combination works, and we try to provide examples of decision mechanisms, which illustrate these various options in different fields. Note, however, that the last column of this table does not correspond to “actors”, but to processes of decision making. For instance, the third line of the last column should be understood as a situation in which the global regulations will result from confrontations among groups of interest organized in lobbies dealing among each other on the basis of quid-pro-quo exchange. The fifth line corresponds

to a situation in which the regulation would result from negotiation among competing organization promoting their own vision of the collective interest.

3.2 Capacity of alternative institutional frameworks to generate knowledge

To analyze how alternative decision/governance mechanisms might impact on the process of knowledge generation, we review how the different characteristics of a process of collective decision (presented in section 3.1.2) impact on the various criteria of performances (proposed in section 3.1).

Being interested in the analysis of actual governance issues, it is useful to consider the generation of knowledge as a process made of two different analytical steps²⁵: (i) focus and framing of problems and issues (Schön 1983, Schön and Rein 1994) (ii) and innovation, testing and filtering of operational solutions. These two steps refer to the contradicting requirements of opening up and closing down in social problem-solving processes (Voß, Kemp and Bauknecht, 2006). On the one hand, problem-oriented interactions need to be opened up to take account of the interaction of diverse factors, preferences and interests. This is necessary to produce robust knowledge and strategies. On the other hand, selection of relevant factors, decisions about ambiguous preference rankings and convergence of interests are necessary to make decisions and act (compare the discussion of exploration and exploitation in March 1991). We qualify the resulting knowledge of each of these steps as respectively (i) “Framework knowledge”²⁶ and (ii) “Operational knowledge”. Since knowledge about issues is more oriented toward the establishment of (collective) preferences than knowledge about solutions that address the most effective (and less costly) ways of addressing these issues, we analyze the influence of the various characteristics of governance on the two types of knowledge in sections 3.2.1. and 3.2.2. respectively.

3.2.1 Issues /Framework Knowledge

An efficient mechanism for identifying issues has to be able to draw attention on the most salient issues (focus) and to structure information through association, generalization and inference (formalization). This requires mechanisms for drawing attention to problems that have to be considered (new contexts or new ways of considering the contexts) and procedures for structuring the information coming from a broad set of cases of local dysfunction.

To go further, we need however to discuss how the various characteristics of governance mechanisms can impact on the various criteria of performance in matter of knowledge generation. We thus consider successively the influence of the scope (a), orientation (b), organization (c) and decision (d) on our six criteria of efficiency (i to vi).

The scope (a) refers to the size of the community considered by the decision mechanism and therefore to its diversity since a community of a wider scope should include more heterogeneous stakeholders. It is obvious that the wider the scope, the higher adequacy with

²⁵ In taking a process view we construct categories that represent different analytic steps in the knowledge production cycle. Of course, this is not a diachronic representation of the way the process will be implemented in practice. The different steps are complementary and in practice there is a continuous back and forth between the initial and final steps of the process. Moreover, we rely on a now rather standard vision of what the process of knowledge creation consist in, which is consistent with both our understanding of knowledge as “solutions to problems” and with the economics of knowledge. Knowledge creation result from (1) re-combination of existing knowledge through association, generalization and inference; (2) expression new ideas; (3) filtering and testing the new knowledge and (4) making it available to decision makers.

²⁶ We define “framework knowledge” as the broad conceptual, epistemological and normative perception of a problem or an issue which determines the way actors approach and think of a problem. Framework knowledge has also been described as mental maps (Gould and White 1986).

the global aspect of GPG (i). Moreover, the wider the scope, the more interests and the more interdependencies can be taken into account. It should therefore lead to the genesis of more knowledge (ii), than if, everything equal, the scope is narrower. Here we do not take into account the possible negative incentives of individuals to reveal which is not directly linked to the size, but to the other criteria: orientation, organization and centralization²⁷. There is also no reason to postulate that individuals would have less incentive to reveal their own needs or the collective problems they identify in a wider community. A wide scope should however have two negative effects on speed and costs of coordination. Indeed, the wider the scope, the higher the complexity of the decision. Therefore, the slowest decision and knowledge generation processes (iii). In the same line, the larger the number and the diversity of the stakeholders involved in the decision process, the highest are the costs of coordination (vi). The number and diversity of stakeholders should not directly impact on accessibility (iv) and duplication (v), since both are depending of the organization of the decision.

Orientation (b) refers to the logic on which the governance mechanism is built. The more the decision maker(s) is(are) oriented towards the inclusion of the interest of all stakeholders in the society, the higher the adequacy with the collective aspect of GPG (i) and the higher the ability to identify relevant interdependencies among individuals and issues (ii). Also, orientation towards inclusion should favor accessibility, since decision makers should consider it more positively (iv). However, more “inclusiveness” leads to more complex decisions, since more interdependencies have to be taken into account. It should reduce the speed of decision and therefore the speed of knowledge generation (iii). The impact of a “more inclusive” orientation on costs of knowledge generation is more questionable. Inclusiveness leads to assess needs and preferences of more stakeholders, which could raise costs. One might consider however that these costs are essentially depending upon the organization of decision-making. An adequate design of the decision process should be able to control for most of the waste due to potentially inefficient use of cognitive resources and to coordination costs. However since what is needed is revelation by the stakeholders about needs and issues, well designed surveys and information gathering mechanisms can very well provide the necessary information to decision makers without involving all stakeholders in the process of decision making. Nevertheless inclusiveness requests everything equal more information gathering efforts than exclusiveness. Moreover those who make decision have to absorb knowledge and information coming from individuals and groups that are different from them, which includes divergent cognitive frameworks. This implies not only to gather and to synthesize more heterogeneous information, it also induces to dedicate learning capabilities to that process. We therefore consider that an orientation toward more inclusion should, everything equal, raise the amount of resources spent to produce the relevant knowledge to identify issues (v), while it should not directly impact on the cost of coordination (iv).

The notion of organization of the decision making (c) refers to the fact that collective decision is clearly made by a process by which stakeholders explicitly aggregate their individual wishes or ideas. To the opposite, collective decision can simply result from a process of spontaneous aggregation of individual decision, which guarantees neither the consideration of all individuals’ preferences, nor the accumulation of all contributions. The fact that the collective decision-making is organized rather than spontaneous should be neutral on the

²⁷ A classical argument would be that in a wider community, strong heterogeneity of individuals could impact positively on conflictuality which in turn decrease the likelihood to cooperate and therefore to share and generate information. In the same time, conflictuality (or high probability of capture of individual efforts by others), is much more depending upon the organization of the decision making and upon the orientation of the logic of coordination in the group.

adequacy of the generated knowledge (i). An adequate organization allows taking into account interdependencies but spontaneity allows taking into account local specificities/needs. Because of the same type of balance between two trends, the impact on speed is not obvious. Organized decisions rely on specialization and development of information networks that allow sharing of information and knowledge and increase the speed of decision. At the same time, organization does not allow quick mutual adjustments and tends to rely on routines which reduce likelihood to locally innovate (if it is not explicitly the purpose of the organization), which might reduce the reactivity, creativity and therefore speed of knowledge generation. We therefore consider that this criterion of “organization” is neutral as far as it concerns the speed of knowledge generation in matter of identification of issues and needs (iii).²⁸ The explicit organization of a collective decision process should impact positively on three criteria: revelation, accessibility and efficiency in the use of cognitive resources. While there is a trade-off between revelation (of unconventional knowledge thanks to spontaneous processes) and accumulation (allowed by organized process of decision), only some organization of the decision allows accumulation of knowledge on the relevant needs and interdependencies in (wide and heterogeneous) communities. More organization of the decision process favors therefore the revelation/production of knowledge (ii). Second, organized decision relies on specialization and development of information networks that allows to share information and knowledge. It increases accessibility (iv). Third, by definition, organized processes of decision are designed to allow a more efficient use of the existing knowledge base and of the cognitive resources (v)²⁹. Organized decision is however more costly in terms of coordination (vi), since spontaneous decision does not request coordination (while it leads to poorer results in terms of genesis of knowledge).

The fact that the collective decision is centralized (and delegated) rather than based on direct interactions/agreements among stakeholders (d) should be neutral on the adequacy of the generate knowledge (i) since contradictory factors need to be considered. On the one hand, centralization allows taking into account interdependencies. On the other hand, decentralization allows taking into account local specificities and needs. Centralization has however a clear negative impact on two issues. First, it reduces the ability to reveal/produce relevant knowledge (ii) because the existing information asymmetries between the decision makers and stakeholders create problems of revelation and might allow the decision makers to manage their private agenda rather than those of their principals. Second, it reduces accessibility (iv) since only decentralization requires and provides incentives for greater accessibility because it relies on knowledge sharing and mutual understanding. The positive impacts of centralization are threefold. Centralization accelerates decision and therefore knowledge generation (iii). Indeed, it relies on formal mechanisms to gather information and make decisions quickly. In addition the centre can accumulate information and learn, and is incited to develop its capabilities to do so. Also centralization is aimed at reducing costs of decision (provided it is associated to a relevant organization of operations). By definition, centralization avoids duplication of efforts and is aimed at optimizing the use of cognitive resources (iv). In addition, centralization reduces coordination costs since there are fewer links to manage in a star network than in a mesh network.

²⁸ Of course more precise qualification of the property of the considered organized processes of decision-making would lead to contrast the contrasted cognitive capabilities of, for instance, more centralized vs. more decentralized organization, vertical vs. matrix organizational design, etc. We consider that our typology of governance logics based on four criteria as sufficient for our analysis, while it could obviously be refined.

²⁹ Of course, an organized process of decision can be poorly designed, but our purpose is to contrast spontaneous coordination on the matter with organized processes. Our analysis could be refined, but it is useless at this level of analysis (see note 28).

3.2.2 *Solutions / Operational knowledge*

The second stage of the knowledge generation process consists in innovating and inventing new solutions (prototypes) and in testing and certifying these solutions in different contexts to generate the necessary knowledge about the required implementation conditions. Knowledge generation depends both upon mobilizable cognitive capacities and upon the motivations and the incentives to generate new ideas and perspectives. Capability to specialize means and to focus will be essential. At the same time, the ability to build implementable solutions requires both an access to local knowledge and to the local preferences. Individuals have access to the local preferences, but can mobilize only a limited amount of knowledge. The representatives can, although not completely, access local know-how and knowledge, but they lack access to the local preferences (perhaps with the exception of local authorities). They also lack of innovative capabilities since they are not selected and mandated to innovate. Organized communities have in principle a better access to both innovative capabilities and access to local knowledge. Their relative efficiency is however depending of the way they are organized.

As in the previous section we need to discuss systematically how the various characteristics of governance mechanisms can impact on the various criteria of performance in matter of generating knowledge about solutions. There are in many cases similar argumentations to those applying to the generation on knowledge on issues. However, there are two differences. First, solutions impacts more directly than issues on the distribution of costs (of provision of the GPG) among agents and on the constraints they face to access and uses resources. Decision and knowledge about solutions impact therefore more sensitively on their individual interests. They have therefore more strategic behaviors, fewer incentives to reveal information that could be used against their interest, fewer incentives to share knowledge on solutions (since they could benefit from the exclusive use of this knowledge), etc. Second, the necessity to adapt solutions to contexts of implementation requests, everything equal, more information about the local contexts. This, together with the more selfishness orientation of agents on these issues creates a tension. To put it another way, when dealing with knowledge genesis about solutions, individual interests are more at play, while local information and individual involvement is more crucial, which impacts on the properties of some dimensions of governance mechanisms.

As in the previous case, a wider scope (a) of the decision process influences positively the adequacy (i) of the generated knowledge, and has a negative impact on speed (iii) and on coordination costs (vi). It is also neutral on accessibility (iv) and duplication of efforts (v). However, the impact of the scope on the revelation is inversed for the reasons explained above. The closer the scope the closer to the context of implementation (provided that the global problem is well framed), the more adequate knowledge generated and vice versa (ii).

The orientation of the decision making process (b) in matter of provision of knowledge on solutions is similar to the provision of knowledge in matter of issues on four criteria. Inclusiveness has a positive influence on adequacy (i), revelation (ii) and accessibility (iv) and a negative effect on speed (iii). We may just note that the positive effect on revelation and accessibility are reinforced in the case of knowledge on solutions, since there are strong incentives to analyze in details the side effects of the implemented solutions and to spread knowledge on implementable solutions. There are however significant changes in matter of costs. First, inclusiveness should become neutral on the efficiency in using cognitive resources (v). On the one hand duplication tends to occur because there are redundancies among local situations, while on the other hand marginal adaptations are required to take into

account the specificities of local contexts. To the opposite, inclusiveness tends to increase coordination costs (vi). At the implementation stage, it leads to involve the widest possible number of heterogeneous stakeholders in the decision to allow them to appropriate the solutions and to adapt them to their ends and preferences. This is a factor of adequacy, revelation and accessibility, but it certainly raises coordination costs.

The organization (vs. spontaneity) of the decision process (c) impacts positively on accessibility (iv) and efficiency of use of cognitive resources (v), while it has a negative impact on coordination costs (vi), and a neutral impact on (adequacy) for the reasons highlighted in the previous section when dealing with the genesis of knowledge on issues. There are however changes in the properties of the alternative decision mechanisms when one consider the issue revelation and speed. The degree of organization of the process of decision should be neutral because organization makes the identification of interdependencies more efficient, which contributes to the design of more appropriate solutions and related knowledge, while spontaneity allows revealing information about implementation specificities and also allows local innovation. In fact the trade-off is the same than the one highlighted for this dimension of performance in matter on decision/knowledge on issues. Since local adaptations is of high value in the case of the design of implementable solutions, the weigh of this second dimension in the trade-off is higher than for issues; which explains the difference. The same reasoning applies to the question of speed, which should be higher in the case of spontaneous (rather than organized) coordination on implementation decisions. Since operational decision requires quick adjustments and adaptation to the local context, spontaneous implementation could speed up decisions and the related generation of knowledge.

The centralization (and delegation) of the decision (d) impacts positively on costs of decision (v, vi), and negatively on revelation due to information asymmetries (ii), and is neutral on adequacy (i) as argued in the case of knowledge generation on issues and preferences. It has a different impact on speed and accessibility. Centralization should have a negative impact on speed, while it is positive in the case of issues (iii). Centralization relies on formal mechanisms to gather information and make decisions quickly. However, decentralized decision allows better adaptation of operational decision. By the end there are less needs of back and forth exchanges of information in the case of implementation decision and it is made quicker. The degree of centralization is neutral on accessibility. On the one hand, decentralization requires and provides incentives for greater accessibility. On the other hand, centralization incites to distribute knowledge to the end-users and to package it accordingly. We consider therefore the overall effect as neutral if decision mechanisms are adapted to the logic of the process.

4 Building an efficient governance framework for the generation of knowledge

The analysis developed above leads to point out how various principles of organization of the decision process on the provision of GPG might impact on knowledge generation relying on various criteria of quality and costs. The following tables sum up our analysis. Each of them points out how the combination of our four organizational characteristics (a to d) results in performances regarding each of our six criteria of performance (i to vi). We use a “+” when an organization’s characteristic impacts positively on a criterion, a “-“ when it is negatively. A “=” indicates that there is no specific impact. Each box contains four signs; the first one corresponds to the impact of the scope (a). The three following signs correspond respectively

to the effect of the logic (b), of the organization (c) and of the centralization of the decision making (d) respectively.

These tables help to draw and comment the analytical conclusions of the analysis carried out in the previous section. Indeed, its reading line by line allows to identify the principal expected performances of the 16 governance mechanisms identified on the basis to our typology, since each line corresponds to one of these mechanisms. We start first by general comments, before detailing the comparative analysis of these mechanisms. Indeed, our analysis is based on an assessment of performance that are comparative.

Table 2
A Synthesis on the Performance of Alternative Governance Mechanisms in Knowledge Generation about Issues

Issues /Framework Knowledge									
Scope	Logic of Inter-individual Relationships	Organization of Relationships	Centralization of decision making	Adequacy	Revelation	Speed	Accessibility	Efficient Use of Cognitive Resources	Economizing on costs of Coordination
Wide	Exclusive	Organized	Centralized	+ - ==	+ - + -	- + ==+	= - + -	=+ + +	- = - +
			Decentralized	+ - ==	+ - + +	- + = -	= - + +	= + + -	- = - -
		Spontaneous	Centralized	+ - ==	+ - - -	- + ==+	= - - -	= + - +	- = + +
			Decentralized	+ - ==	+ - - +	- + = -	= - - +	= + - -	- = + -
	Inclusive	Organized	Centralized	+ + ==	+ + + -	- - = +	= + + -	= - + +	- = - +
			Decentralized	+ + ==	+ + + +	- - = -	= + + +	= - + -	- = - -
		Spontaneous	Centralized	+ + ==	+ + - -	- - = +	= + - -	= - - +	- = + +
			Decentralized	+ + ==	+ + + -	- - = -	= + + -	= - - -	- = + -
Narrow	Exclusive	Organized	Centralized	- - ==	- - + -	+ + = +	= - + -	= + + +	+ = + +
			Decentralized	- - ==	- - + +	+ + = -	= - + +	= + - -	+ = - -
		Spontaneous	Centralized	- - ==	- - - -	+ + = +	= - - -	= + - +	+ = + +
			Decentralized	- - ==	- - - +	+ + = -	= - - +	= + - -	+ = + -
	Inclusive	Organized	Centralized	- + ==	- + + -	+ - = +	= + + -	= - + +	+ = - +
			Decentralized	- + ==	- + + +	+ - = -	= + + +	= - + -	+ = - -
		Spontaneous	Centralized	- + ==	- + - -	+ + = +	= + - -	= - - +	+ = + +
			Decentralized	- + ==	- + - +	+ - = -	= + - +	= - - -	+ = + -

Table 3
A Synthesis on the Performance of Alternative Governance Mechanisms in Knowledge Generation about Solutions

Solutions / Operational knowledge									
Scope	Logic of Inter-individual Relationships	Organization of Relationships	Centralization of decision making	Adequacy	Revelation	Speed	Accessibility	Efficient Use of Cognitive Resources	Economizing on costs of Coordination
Wide	Exclusive	Organized	Centralized	+ - ==	- - - -	- + - -	= - + =	= = + +	- + - +
			Decentralized	+ - ==	- - = +	- + - +	= - + =	= = + -	- + - -
		Spontaneous	Centralized	+ - ==	- - - -	- + + -	= - - =	= = - +	- + + +
			Decentralized	+ - ==	- - = +	- + + +	= - - =	= = - -	- + + -
	Inclusive	Organized	Centralized	+ + ==	- + = -	- - - -	= + + =	= = + +	- - - +
			Decentralized	+ + ==	- + = +	- - - +	= + + =	= = + -	- - - -
		Spontaneous	Centralized	+ + ==	- + = -	- - + -	= + - =	= = - +	- - + +
			Decentralized	+ + ==	- + = +	- - + +	= + - =	= = - -	- - + -
Narrow	Exclusive	Organized	Centralized	- - ==	+ - = -	+ + - -	= - + =	= = + +	+ + - +
			Decentralized	- - ==	+ - = +	+ + - +	= - + =	= = + -	+ + - -
		Spontaneous	Centralized	- - ==	+ - = -	+ + + -	= - - =	= = - +	+ + + +
			Decentralized	- - ==	+ - = +	+ + + +	= - - =	= = - -	+ + + -
	Inclusive	Organized	Centralized	- + ==	+ + = -	+ - - -	= + + =	= = + +	+ - - +
			Decentralized	- + ==	+ + = +	+ - - +	= + + =	= = + -	+ - - -
		Spontaneous	Centralized	- + ==	+ + = -	+ - - -	= + - =	= = - +	+ - + +
			Decentralized	- + ==	+ + = +	+ - - +	= + - =	= = - -	+ - + -

Before going into the details, the limits of our analysis have to be reminded to the reader. Indeed, we will establish our comparisons by summing positive and negative impacts on

various criteria. Doing so leads to give an equivalent weight to the impact of each organizational criteria (a to d) on each criteria of performance (i to vi) when assessing a dimension of a performance (i.e. a box in our table) and to give an equivalent weight to each criteria (i to vi) when comparing mechanisms among them (i.e. when comparing lines). To proceed this way is obviously subject to criticism since we weigh neither the relative importance of the various organizational effects, nor the relative importance of the various criteria of quality and costs. At this stage of the analysis of the category of issue we are interested in, we do not benefit of any systematic analysis of the production function of knowledge related to governance mechanisms (neither theoretical nor empirical). Our analysis has therefore to be considered as exploratory and provide, we think useful insights on the relative performance of alternative governance principles. It is clear however, that further theoretical and empirical analyses will be needed to confirm our provisional conclusions and refines them.

4.1 Analysis of the trade-offs

A first sight, the two tables shows clearly that there is no optimal way of generating knowledge on the provision of GPG. Indeed, none of the identified mechanism is the best on all the identified criteria. A reading of our tables line by line highlights that there are tradeoffs among criteria of performance and that all the possible governance solutions have their drawbacks. A reading of our tables column by column allows pointing out some of the dimensions of these tradeoffs. It allows, also, identifying the combination of organizational characteristics that best ensure performance for each of our criteria. We will group them into three categories: adequacy (i) and revelation (ii) refers to the relevancy of the generated knowledge for the provision of GPG; speed (iii) and accessibility (iv) refers to availability of the process; efficient use of cognitive resources (v) and cost of coordination (vi) refers to costs of production.

On the basis of our categories to evaluate the knowledge generation processes (see table A2 in the appendix), one can note two general “organizational” impacts that are independent of the type of knowledge. First, the logic of relationships (b) has a strong influence on the relevancy (i and ii) of the produced knowledge: inclusiveness enhances quality. Second, centralization vs. decentralization of the decision (d) impacts on costs (v and vi): centralization allows better performance on the matter. One can also note three contrasted effects, depending upon the nature of the knowledge. First, the scope (a) has a strong influence on the relevancy (i and ii) of the knowledge on issues: wideness favors quality on issues, while it is neutral for knowledge on solutions. The same holds for the organization (vs. the spontaneity) of the decision mechanism (c), which influences the availability (iii and iv). In the case of knowledge on solutions, it is centralization (d) that influences availability (iii and iv): centralization reduces efficiency.

The association of inclusiveness and decentralization seems to favor revelation and production of adequate knowledge (i and iii). There is however clearly a quality vs. cost dilemma since the mechanisms that produce the most relevant knowledge for the provision of GPG are also the most costly. This is true both for knowledge about issues and knowledge on solutions, while in the former case, the scope has to be wide to result in relevant knowledge. It does not seem to exist the same dilemma between efficiency and costs, or between quality and efficiency.

Generally speaking, when one considers the organizational dimensions that induce the best performances, the three categories of performances request different organizational/governance characteristics:

- The best solutions to generate relevant knowledge (i and ii) on issues associate wide scope and inclusiveness. While the best solutions to generate knowledge on solutions rely on the association of inclusiveness and decentralization.
- The best solutions to produce knowledge that is available quickly and widely (iii and iv) combine narrowness and organization in the case of issues. They combine narrowness with decentralization in the case of solutions
- The best solution to minimize costs is to rely on processes focusing on a narrow scope, based on exclusive interests and centralization

It is therefore clear that the design on efficient governance mechanisms should rely on a logic of hybridization among governance principles based, either, on mechanisms combining various logics of decision, or on combination of alternative mechanism in the same process of governance.

4.2 Comparative Analysis of Governance Frameworks

A last step in our analysis consists in a “line-by-line” discussion of the tables with regard to the performance of the 16 cases. We focus here on the most significant mechanisms; the systematic discussion is being developed in tables A3 and A4 in the appendix. It confirms our synthesis in pointing out that there is no best way to generate knowledge and the provision of GPG. Indeed, those mechanisms that are efficient on dealing with issues perform poorly on solutions, and vice versa. We first discuss the cases that have an overall balanced assessment, both on issues and solutions, without having necessarily the highest score on these dimensions considered individually. Then we turn to a discussion of the mechanisms with the best and worst performance on issues and solutions separately.

4.2.1 Assessing the most balanced mechanisms over the two dimensions

In the overall assessment, the best-balanced score over the two dimensions can be found in the cases that combine narrow scope, inclusive relationships and organized decision making. This characterizes what is qualified in table 1 as *Service providing non-profit organizations* and *Communitarian management organizations to characterize modes of governance*. These mechanisms perform well in both fields, in generating knowledge on issues and in generating knowledge on solutions. The main difference between the centralized case and the decentralized case lies in the trade-off between costs and quality of knowledge. Centralization of knowledge generation in Service providing non-profit organizations diminishes the cost, but this goes together with a decrease in the quality of the knowledge.

Service providing nonprofit organizations show the best overall performance both over issues and solutions. Nonprofit organizations are organized entities that exist separately from the state, have a voluntary membership, are self-governing and are oriented towards the general interest (Salamon *et al.*, 1999). Service providing or operational non-profit organizations moreover are problem solving oriented³⁰. The learning processes in those

³⁰ We take this distinction from the literature on NGO organisations, which differentiates between : 1) *operational* NGOs - whose primary purpose is the design and implementation of projects, and; 2) *advocacy* NGOs - whose primary purpose is to defend or promote a specific cause and who seek to influence the policies (Defourny *et al.*, 2005). As the term NGO often denotes a specific type of organisation, whose legal nature differs from one country to another, we prefer to use the term nonprofit organisation. The term non profit is more general and has been widely used in the systematic comparative research on civil society organisations such as the John Hopkins Comparative Nonprofit Sector Project.

organizations are participatory in character, because of the voluntary membership, and, in the area of their operational mandate, the results of the learning process can be integrated directly in the decision making process. This type of governance mechanism has been widely used in the field of development cooperation and nonprofit health service provision, but is now also increasingly used in the field of environmental service provision. An important example of the latter, which is especially relevant for global public goods such as climate change mitigation and biodiversity, is the provision of ecosystems management services by non-profit organizations. For instance, an in depth case study of the Kristianstad watershed in Southern Sweden shows how careful networking and knowledge integration by the Biosphere Office – formally the Kristianstads’ Ecomuseum – lead to successful institutional innovations and enhanced provision of ecosystems services (Olsson *et al.*, 2007). From a knowledge generation perspective, the main focus of the governance process was on the integration of different disconnected perspectives of user groups and environmental advocates in the region. This resulted in a major change in the cognitive framing of the management problem, through the adoption of a landscape approach, and a change in the perception of water by the authorities and user groups from a problem to a valuable resource with several values of use, such as bird conservation, cultural heritage and tourism potential. The elaboration for solutions on local conflicts over these values of use, raised for instance by the harm of crane birds on the crops, was made possible through trial and error experimentation with practical measures to alleviate the harm, a lot of which had already been tried out previously in a nearby locally managed wetland area.

Integrated and adaptive knowledge management by nonprofit service providers has been especially well studied in several other cases of adaptive ecosystems management in Unesco Biosphere Reserves (Brunckhorst, 2001). Similar robust outcomes from learning processes managed by nonprofit service providers have been documented in other fields. Some well-studied examples are voluntary joint forest management organizations in Flanders (Van Gossum and De Mayer, 2006) and river basin coordination in Hungary (Sendzimir *et al.*, 2006), all of which resulted in extended provision of a mix of local and global ecosystems services. The effective contribution of this type of mechanism to GPG provision depends of course also of other factors. Most studies mention the importance of pervasive trust, appropriate fit between the scope of the regional management organization and the ecosystem and compatibility of the management options with economic incentives. When these are missing, the literature reports a history of inefficiency, inappropriate monitoring and high transaction costs (Brunckhorst and Reeve, 2006 : 159-160).

Communitarian management organizations show a similar performance to the Service providing nonprofit organizations. They also have similar governance characteristics. The main difference is that the knowledge generation process is organized through a decentralized mechanism of self-governance by the resource users in a decentralized network and not by a separate nonprofit entity. In their detailed review of the empirical literature on natural resource management by communities or user groups, Jean-Marie Baland and Jean-Philippe Platteau have shown the various strengths of self-governance by users from a knowledge generation perspective (Balland and Platteau, 1996, pp. 348-351). First, local communities or user groups are well informed about the local ecological conditions, even if they possibly miss or misjudge recent evolutions of their environment or ascribe wrong causes to visible ecological processes under way. Further, they are well informed about local technical, economic and social conditions, as well as about the cultural patrimony on which they can

draw to meet new challenges. This second aspect is especially relevant in the context of the problems considered in this paper, where collective preferences and common understanding on GPG provision still have to be built. In addition, rules developed locally through self-governance often result from extensive trial and error by the users, which ensures not only that they are well suited to local conditions, but also that they are well understood by the concerned people. However, to the extent that the state is comparatively more efficient in processing (rather than collecting) crucial information, it can provide technical assistance or guidance to user groups or communities. Further, when monitoring activities necessitate the use of costly technologies and equipment to be effective, the government might provide financial and technical support for decentralized monitoring. Other weaknesses of the communitarian management organizations are the incomplete information and bias, which exists on the understanding of changes in the broader environment and the scientific knowledge on the processes of resource depletion and degradation. Nevertheless, as stated by the authors, from an information gathering perspective, the government is clearly at disadvantage compared to the historic users who can be expected to possess extensive knowledge of local resources and constraints (*Ibid.*, p. 246).³¹

Other cases where communitarian management organizations contribute to GPG provision have been widely documented in the literature³². From a knowledge generation perspective, one of the main conditions stated in Dolsak and Ostrom, 2003 and in Dietz, Ostrom and Stern, 2003 is the organization of a well structured dialogue involving scientists, resource users and interested publics: “(...) such analytic deliberation provides improved information and the trust in it that is essential for information to be used effectively, builds social capital, and can allow for change and deal with inevitable conflicts well enough to produce consensus on governance rules” (Dietz, Ostrom and Stern, 2003, p. 1910).

Another category of governance mechanism scores positively in the generation of both types of knowledge. It is labeled as ***national government***. Indeed, except for the communitarian management organization and the service providing nonprofit organization, this is the only type of governance mechanism that has been positively assessed in terms of performance both on issues and solutions. From a knowledge generation perspective, it has many similarities to the service providing nonprofit organizations, as it is characterized by organized and centralized decision making. The main difference lies in the action orientation, which is based on exclusive interests. In our analysis, such governance mechanism generates good results on issues and moderately good on solutions. Performances are contrasted on issues : it is very good on speed and duplication, while rather bad on revelation and very bad on adequacy. In general, the strength of such governance mechanism is its low costs.

³¹ To compensate for some of the weaknesses of community management, the authors argue in favour of a co-management approach based on collaboration between government and rural communities. In the latter case, because dealing with each user group individually would entail considerable transaction costs for the government, co-management would ideally require the building of intermediary organizations that represent the interest of multiple user groups and communities (*Ibid.*, p. 351).

³² Prominent examples in the field of global biodiversity include for instance the conservation of traditional crop varieties in community managed seed exchange networks (Brush, 1998) or the exchanges in the network of the Consultative Group on International Agricultural Research (C.G.I.A.R.) (Fowler, Smale and Gaiji, 2001). The conditions for successful functioning of communitarian management organizations have been extensively documented in the literature. Most comparative case studies mention the importance of rules for controlling access to the common resource by outsiders and the design of rules regulating the allocation of resource use (Balland and Platteau, p. 187). Further, because of the threat of a domination of local self-organization by local elites which use the rules as tools to advance themselves, governance systems at multiple levels are needed to cope with poorly performing systems at any level (Ostrom, 2005, p. 221). Finally, for problems related to the global commons, supplementary conditions are required. Indeed, we discussed here mechanisms to ensure local production of different goods and services which also have an important global component, such as biodiversity. However, for problems which require direct management at larger scales, such as transboundary pollution, these will not be sufficient. Several of these supplementary conditions have been reviewed elsewhere (Dolsak and Ostrom, 2003 ; Dietz, Ostrom and Stern, 2003).

The balanced positive performance of the national government can be illustrated with the example of state managed integrated resource management. A case in point is the state owned Finnish resource management enterprise Metsähallitus. Metsähallitus manages and administers almost one third of Finland's territory, more than 12 million hectares of state-owned land and water areas, including many of its main natural resources – forests, shores, waters and soil resources. Knowledge integration is accomplished in Metsähallitus through integrated landscape planning, the use of digital information systems and extensive face-to-face communication with regional and local stakeholders. Ecological, social and commercial use of the natural resources is digitally mapped for the whole area up to a precision of single trees in the landscape and kept up to date through a wide set of deliberative processes. Sustainable resource extraction is managed through real time information processing of resource extraction decisions based on a system of satellite communication between loggers, retailers and central managers. Even if progress is still to be accomplished, in particular to integrate the new ecosystems focus of international conservation programs, Metsähallitus is internationally considered as a very good example of what can be achieved in sustainable management, combining commercial activities with contribution to both local and global public goods provision (Gilligan *et al.*, 2005). Similar results of state governed integrated planning and implementation process in the field of biodiversity have been documented, both in OECD and in non-OECD settings such as in Kyrgyzstan (Kouplevatskaya, 2007, Chorfi, 2007). The main drawback of such mechanism is that it is organized at the national level only. At the international level, conflicts of interest among national communities can hinder the solving of problems of global concern.³³

A related mechanism to national government with some balanced performance is **local direct democracy**. It has similar moderate scores on solutions, but performs only in the intermediary range on issues. Local direct democracy has its main strengths in the speedy generation of knowledge on solutions. It is a relatively fast process to come to a generally accepted decision as well as to generating new knowledge on ways to solve the problems at hand.

A well-studied example of local direct democratic procedures are local referenda. Referenda have been used in many countries to decide upon local environmental issues, but they have also been conducted on the national level – the Swedish referendum on nuclear power, for example. In general a referendum requires some framing by political actors in advance. When Stewardson (1903, p. 134) defines the referendum as “the ratification or rejection by a majority vote of laws or measures framed elsewhere by representatives in convention or legislature assembled”, he explicitly alludes to the external framing of the issue of the referendum. The form of a referendum necessitates a somewhat simplified form of question that allows citizens to vote for or against a certain regulation. Given this necessity, the form of a referendum also helps to channel decision making processes into specific questions and the formulation process of this question is to be seen as a first key step in the framing of the issue (Vreese and Semetko 2004). The decentralized form of decision making is most helpful for the revelation of citizens' preferences within the limits of the referendum question. As

³³ At the infra-national level, conflicts of interest can also occur when the national government is unable to arbitre among conflicting claims. For instance, one of the main drawbacks of centralized deliberative planning described in the Finish case is the conflicts over property rights. This has for example been the case with the difficulty of Metsähallitus to deal with conflicts with indigenous communities over reindeer grazing in the state forests. Researchers and managers have been gathering more knowledge on the different social values associated with sustainable forestry, mainly recreation and climate change mitigation, in order to find the appropriate balance between sustainable management and the protection of indigenous reindeer culture. However, the conventional framing of the debate in terms of multi-purpose sustainable forest management does not seem to lead to any progress in the acceptance of the management plans by the indigenous communities, in spite of the recourse to a number of multi-stakeholder deliberative planning processes at the local and the regional level (Piiparinen and Kotisaari 2006) . Hence, as has been shown also elsewhere, in cases of conflicts over property rights, problems of redistribution of power restrict the possible scope of the deliberative planning exercise (Kouplevatskaya, 2007).

Kirchgaessner, Feld and Savioz (1999) claim, the form of a referendum particularly helps in forming opinions and evaluating possible solutions when citizens are also granted the right to initiate referenda by themselves as it is the case in Switzerland. In their perception, referenda can help to overcome the domination of specific interest groups in representative political processes and thereby help to include more bodies of knowledge into the discussion and the decision making process. Thus, Bohnet and Frey (1994) stress the particular and highly inclusive discussion dynamics of referenda as a strength that can hardly be found with representative elections.

Local direct democracy is also the field where participatory procedures have proven to work best. While their applicability on global scales remains under debate, local and regional approaches to include citizens and stakeholders from different backgrounds into specific decision-making procedures have been fruitful endeavors of simultaneous knowledge generation and decision-making on global public good related issues, such as climate change mitigation or energy policy choices. However, most hitherto examples of participatory mechanisms have been stronger in formulating recommendations rather than in forging formal political decisions. Thus, the broad literature on citizen juries and citizen advisory panels shows that these procedures are well capable of bringing different values and solutions to the table and to form consensus or a common understanding of the preferred frames and solutions. As examples by Hisschemöller et al. (2001) on technical solutions to reducing CO₂-emissions and by Kasemir et al. (2003) on forming local preferences and finding communal responses to climate change show, participatory processes can generate common results also through the formation of common preferences and the interactive generation of potential new solutions or compromises (Siebenhüner 2004). However, the particular methods applied lead to different results with regards to solutions and preferences (Toth and Hizsnyik 1998, Rotmans 1998, van Asselt and Rijkens-Klomp 2002). It is the particular strength of the use of computer models in such participatory approaches to structure existing knowledge and to provide a tool for assessing future scenarios. However, the underlying values are hardly made explicit and thus the formation of preferences cannot be granted by such methods (Siebenhüner and Barth 2005). This task needs additional approaches to form common understanding of the issues at hand and to make explicit existing value structures and possible commonalities in these values (Webler et al. 1995).

The main weakness shown by these reviews of public participation in knowledge production lies in the relevancy of the produced knowledge. Most of these processes are citizen focused, which means that citizens were recruited on the basis of demographic data rather than on an equal representation of stakeholder interests (Siebenhüner 2004). Moreover, face-to-face interaction is limited to small to medium-sized groups and to a certain location where all participants have to be present. Large scale problems with a large number of individuals from various backgrounds and with numerous languages can hardly be dealt with in a citizen-based mechanism³⁴. That's why James Meadowcroft, in his comparative assessment of deliberative mechanisms (2004), argues in favor of group-based mechanisms, where the seats at the table are allocated to groups (companies, trade associations, nongovernmental organizations (NGOs) and governmental organizations). Examples of these processes analyzed by Meadowcroft are environmental covenants (direct agreements between governmental

³⁴ Another well studied example of citizen-based participatory procedures in the field of environmental governance is the implementation of agenda 21, the blueprint for the development of sustainable development plans by local authorities, which was agreed upon at the 1992 Rio conference. The moderate performance of these initiatives is related to the framing effect in terms of local preferences. For instance an in depth case study of two UK agenda 21 initiatives showed that the initiatives were hardly able to generate learning beyond the existing frames reflecting essentially local concerns such as urban regeneration and economic opportunities for the youth (O'Riordan, 2001, p. 233).

agencies and industry representatives), negotiated regulation (negotiation of concerned group representatives on draft regulatory rules) and environmental mediation (mediated agreement amongst concerned group representatives). According to Meadowcroft, the main strength of these mechanisms lies in their better performance on decision and execution of agreed upon solutions. These mechanisms also have some knowledge related advantages, such as the specialist knowledge that the participants bring to the process at the outset, their capacity to absorb technical issues more readily, and the time stakeholders invest in the process (*Ibid*, p. 202). Nevertheless, the role that some of the participating stakeholders play in the actual execution also puts some constraints on the range of acceptable solutions. As has been shown by a comparative assessment of a set of 47 broadly representative case studies, group based deliberative processes lead to an adequacy – implementation trade-off : on the one hand, the ‘quality’ of decisions with respect to more environmentally sound outputs was rather lessened than improved through participation. On the other hand, participation did indeed foster the effective implementation of these decisions (Fritsch and Newig 2007, p. 12).

Nevertheless, most of these approaches to stakeholder and citizen participation are only loosely linked to political decision making; if at all. They often run in parallel and feed their results into actual regulatory processes run by public authorities or parliaments. As such, participatory assessment processes seem well suited for evaluating solutions from the point of view of key stakeholder groups whereas they are not well equipped as decision making processes, neither on local nor on national or global scales.

All this confirms our general conclusion on the necessity to hybridize, to rely on contrasted mechanisms to generate decision (and knowledge) on issues vs. solutions, and to compensate for the intrinsic weaknesses of some mechanisms by the strengths of others. Some well-studied examples of this hybridization are given in the analyses of performance of national governments (Lafferty and Meadowcroft ; Dryzek, Downes *et al.*). As comparative studies have shown, knowledge generation and integration of sustainable development issues in national policies over the last 15 years have been most successful in the cases of national governments that combined active state steering with openness to civil society movements and which had a supportive involvement with international organizations (Lafferty and Meadowcroft : 422-423).

4.2.2 *Assessing the best performing mechanisms over one of the dimensions*

When turning to the analysis of the best scores on the generation of knowledge on issues considered separately from solutions, we see that the combination of a logic of decision based on inclusive interest, with a decision which is centrally organized — i.e. the logic that lies behind *Service providing nonprofit organizations* and *NGOs coordination* — is clearly the most efficient solution to provide knowledge on issues. The first governance mode has a narrow scope and has been discussed in the previous section. The second is wide in scope. It is amongst the best governance regime on issues, but it has moderately poor performances on solutions. More precisely, **NGOs coordination** is very good in adequacy and revelation of issues. It is also efficient on adequacy when dealing with solutions. In this last case, however, it is slow on implementation. Generally speaking, the drawback of these mechanisms lies in the costs of coordination. The good score of this mechanism can at first sights appear counter-intuitive if one considers the vast empirical literature on the issue (Nanz and Steffek, 2007). For instance, the role of NGOs in social learning on climate issues has been extremely modest as shown by by the Social Learning Group on climate change, ozone depletion and acid rain (cf. Clark *et al.*, 2001a ; 2001b). As stated by Schreurs and al. (2001 : 363), “most NGOs acted only when they perceived that issue frames and scientific evidence would allow them to

target a particular industrial activity or consumer behavior”. NGOs coordination precisely attempts to go beyond this parochial character of a lot of NGO activism. The International Union of Nature Conservation/World Conservation Union (IUCN) — the umbrella organization of the nature conservation NGOs — has been playing a major role in the emergence and the shaping of the ideas behind the Convention on biological diversity (Louafi, 2001). It was very strong at building upon and integrating the different cognitive frames and collective preferences, in particular through integrating economic framing in conservation discourse. However, as the study shows its main weakness remains the absence of learning opportunities on the proposed solutions based on the know-how of the concerned actors³⁵.

The two other solutions that are efficient in providing knowledge on issues are both characterized by a wide scope and organized decision, but they have contrasting characteristics on the other dimensions. The first relies on inclusiveness and decentralization — which is the case of the *Republic of Science* — and the other relies on exclusiveness and centralization — which is the characteristic of confederated political systems, labeled here as *Global Confederation*. They both perform badly on solutions, even if the first one performs in fact much less inefficiently on solutions than the later. More precisely, governance mechanisms like those in force in the scientific communities are good at generating knowledge on issues and moderately bad on solutions. They are very efficient in matter of adequacy, revelation and accessibility, while they tend to be quite costly and slow. On the other hand, mechanisms as those in force in global confederated governance mechanisms are efficient at generating knowledge on issues, but poor on solutions. These decision mechanisms are among the best in ensuring efficient use of cognitive resources. Their poor performance on solutions is explained by their inefficiency in revealing the adequate knowledge on condition of implementation and by slowness.

The importance of the global science communities and the confederal institutions in generating knowledge has also been confirmed by the cross-country comparison on social learning in climate change (Clark *et al.*, 2001a ; 2001b). In particular, the quality, availability and cost of the knowledge generation process in the case of the global science communities has been extensively studied. Cases like the Intergovernmental Panel on Climate Change (IPCC) echo the good performance of these mechanisms for building knowledge on the issues. This has been analyzed in terms of the criteria of credibility, saliency and legitimacy. Both credibility and salience of the produced knowledge rank high (Mitchell *et al.* 2006, Siebenhüner 2006), while legitimacy has at times been contested, but this seems more related to the practical problems of including all the stakeholders, rather than due to an intrinsic limitation of the decision making process itself (Haas 2005). The main drawback is on the production of operational knowledge, where the problems of cost and slowness are no longer compensated by excellent performance on revelation. Indeed, both building well-targeted usable knowledge (Haas, 2004) and ensuring access to context-based appraisal of climate change (Biermann, 2001) have proven to be major difficulties in climate assessments.

The performance of Global Confederations, such as multilateral environmental institutions, on operational knowledge is even worse, in spite of the increased cost-effectiveness due to the centralization mechanism. Multilateral institutions are more weakly tighten with local actors settings than the science communities. Moreover, these institutions suffer from many other

³⁵ Because of lack of funding in the mid-nineties, IUCN has been progressively involved in project management. For instance, through a network of local focal points, it manages the monitoring of the implementation of the Ramsar convention on wetland management. As such it develops a competence on “solutions”, but this is linked to a switch in the decision making mechanisms, which focuses less on global NGO coordination.

problems, such as missing links, conflicting functions, poor mandate and lack of stakeholder involvement (Iwama, 2004 ; Young, 2002 : 111-138). Nevertheless, the gain in cost-effectiveness of the centralization and exclusive mechanism can sometimes produce major results, if used in combination with other mechanisms, such as NGOs coordination and global science communities. This has been the case of the United Nations Environmental Program (UNEP), where a small secretariat of a few hundred persons was able to move the international community towards the 1992 Convention on Biodiversity and Global Climate Change, especially through its capacity to build collaboration with NGO, with coordinating organizations as IUCN, with scientific communities, with intergovernmental organization as the World Meteorological Organization through a set of targeted projects (Haas and Haas, 1995 : 269). In general, it is beyond doubt that international regimes played a major role in generating new knowledge on global public good provision, especially through their contribution on framing and selection issues and effective use of analytical tools (Young, 2004), even if they have sometimes few impact on elaborating real solutions (*Ibid* : 224-225).

When we turn to the best scores on knowledge generation on solutions separately from issues, we see that the most efficient mechanisms are all provided by the narrow and inclusive mechanisms. This is the case of the *Communitarian management organization* and the *Service providing NGOs*, where coordination is organized. These cases have been discussed in the previous section, because they are also amongst the most balanced solutions. However, two other cases with good overall scores on solutions remain to be discussed, which are *Local activism* and *Neighborhood action*, both based on spontaneous coordination mechanisms. The main strength of local activism is its low cost, which gives it a rather balanced performance, very good on solutions and medium on issues. Neighborhood action on the other hand draws its strength from the production of relevant and accessible solutions. However, because of its low cost-efficiency it scores very badly on issues.

The case of *local activism* is interesting, because it is very prominent in the literature on social constructivist approaches to technology (Kemp *et al.*, 1998). This literature shows how new technical knowledge can be generated through bottom-up experimentation with sustainable technologies and diffused through networks with a shared value orientation. A very prominent example is the Danish wind energy industry (Smith, 2006). Danish windmills have been developed in the 1980ies by local activists with the help of farmers and improved through local wind cooperatives. The Danish wind industry is now the world leader and commands more than half of the world market. Other examples of successful niche innovations are the Austrian solar heating technology (p. 326), disseminated through cooperatives and solar clubs, and organic food (p. 331). From the point of view of knowledge generation processes, niche-based approaches are able to use decentralized experimentation to generate new technical knowledge, learn lessons by user involvement in the testing of different designs and techniques and disseminate the results through the demonstration of alternatives. The main weakness lies in their local character. Broader change depends on other mechanisms, such as governmental support for decentralized development of technological alternatives. Analysts argue that policy support for grassroots innovation placed the Danish wind industry in a favorable development trajectory (p. 321). Policy for wind energy in other countries focused R&D around big Megawatt, high-tech projects and technology push. While these projects contributed to wind energy science, all were practical failures. The relatively simple, extensively road-tested Danish design performed better.

Neighborhood action is very bad on generating knowledge on issues. Indeed it shares with local activism low quality of knowledge on global issues. It is also not cost effective, as

efforts are duplicated because of lack of organized decision-making. Nevertheless, for a given issue, it is amongst the best mechanisms to build knowledge on solutions (which is common to all the narrow and inclusive mechanisms). The main reason is the comparative advantage of neighborhood action in revealing operational solutions and diffuse them at high speed. In its most extreme form this type of mechanism has been qualified as “populist” governance (De Witt, 2004, pp. 225-226). It is characterized by distrust of central authority and motivated to action by specific threats or opportunities. Hence it is place and situation specific. One can find this type of mechanism in “not-in-my-backyard” protests (NIMBY) or, in its proactive form, in local cleanups or efforts to build a local park, without worrying too much about underlying causes. Prominent examples are the protest against toxic waste dumps at Love Canal near Niagara Falls in New York State, which sparked the creation of the Superfund program in the US³⁶. Comparative case studies on neighborhood initiatives for sustainable development confirm this contrasted performance on issues and solutions. The frames adopted by communities in neighborhood action are mostly related to local issues such as communitarian health (Laws, 2003) or urban regeneration (Voisey, Walters and Church, 2001). As such, there is no direct contribution of this governance mechanism to the generation of knowledge on GPG. In fact, through neighborhood action, communities build new social identities in translating global concerns to local concerns (O’ Riordan, 2001). Where these local concerns and global issues overlap, such as in issues of environmental justice or distributional matters over local impacts of global issues, neighborhood action can be nevertheless a quick way to reveal possible solutions. This potential for problem solving has even lead to some interesting governance innovations, such as in Japan, where NIMBY protest has been used for finding solutions over compensatory payment for damage caused to communities by power plants (Lesburel, 1996).

4.2.3 *Assessing the mechanisms with bad or moderate overall performance*

Finally, we turn to analyzing governance regimes with bad scores on solutions or on issues. We already mentioned the quite poor performance of governance mechanisms of the *Global-Confederation* type on the genesis of knowledge on solutions. More generally, all the mechanisms that combine a wide scope and are driven by exclusive interests have the worst performance on solutions. Among those mechanisms, two of them should be highlighted because they perform quite poorly both on issues and on solutions. They are characterized by spontaneity of coordination. The worst is clearly the *Global-free-market* type of mechanism that relies on decentralized decision only. The one based on simple bargaining among groups of interests, the *Global self-regulation* type, is a bit less inefficient on issues. In fact, the only interest of this latter mechanism from the point of view of knowledge generation on GPG is that it is quick and not costly. This might explain that, while it is not efficient from a collective welfare point of view, it is quite successful in the current processes of decision making on global issues. Further, in the context of the evaluation of these two mechanisms, it must be reminded that our analysis focuses on the knowledge generation aspect. It does not evaluate the contribution of global market and global self-regulation type solutions to GPG provision as such. They might be in some cases very efficient, even if they have a poor performance on the generation of GPG related knowledge. Finally, as also stated earlier, the appropriate functioning of any governance mechanism depends on context specific conditions. When these are not satisfied, these mechanisms might also offer a second-best solution, even from a knowledge generation perspective.

³⁶ The Superfund Program gives authority to the US Environmental Protection Agency (EPA) to compel the responsible parties of toxic waste contamination to perform cleanups or reimburse the government for EPA lead clean ups.

Global self-regulation is very prominent in the case of forest governance and many of the drawbacks have also been highlighted in the literature (Gulbrandsen, 2004 ; Overdevest, 2004). The main drawback, shown in the empirical literature on forest self-regulation, is that the revealed knowledge is only the expression of one social group, whether it is pro-industry oriented or conservation oriented. Even within that group, the knowledge revelation is imperfect, because of the difficulty to centralize the knowledge of a wide community of stakeholders belonging to that group. For instance, in the forestry sector, certification schemes that perform rather well in the context of some groups, tend to be rather difficult to generalize to the overall forest management regime. A case in point is the Forest Stewardship Council label (FSC). FSC is an international standard for sustainable wood production, managed through a balanced representation of environmental and social groups, timber trade and the forestry profession. It is a highly successful label and the FSC criteria are considered as the reference case for any certification effort through third-party mechanisms (UNECE/FAO, 2006). However, big timber trade organizations in the EU and the US have lobbied for the creation of competing labels, resulting in the existence of three competing labels each with a market share of around 25%³⁷. Accessibility of the produced knowledge is also a major problem, because of the low incentive to structure the knowledge to make it available outside the initial target group. The qualities of international certification in terms of speed and cost might nevertheless been useful in combination with other mechanisms, such as in forms of regulated self-regulation by the national government. The latter might play a role in particular in imposing some general common constraints on the different labeling schemes, such as has been done in the case of organic farming. The same point is valid for **Global-free-market** type of mechanisms such as tradable pollution permits (see e.g. Tietenberg 1995) or bioprospecting contracts (Dedeurwaerdere, 2005), which reflect often only the point of view of a limited number of involved players. They can nevertheless play a role as a tool for building a quasi-market in environmental goods, as long as complementary mechanisms are in place for broadening the debate to a wider set of involved stakeholders. In the case of global bioprospecting for example, an important stake for these complementary mechanisms is to include non-commercial users such as global science communities and local users communities in the search for solutions to the conservation of global biodiversity.

The **international referendum** is amongst the worst on solutions, but scores in the medium range on issues. It has serious drawbacks with regard to the generation of knowledge on solutions while it scores slightly better with regard to forming knowledge on issues. The argument behind this is straightforward. The idea of an internationally organized referendum — e.g. on environmental protection on a global level — has the potential to help citizens even in their local contexts to form their preferences since they are given the opportunity to decide about international policy issues. Unless the referendum asks for a vote on specific technological or instrumental options, citizens or corporate actors are hardly inclined to develop new solutions. The main drawback of this mechanism however is the high cost of coordination. Further, most parts of the related literature merely discuss referenda on a national or local scale, where direct or partly indirect forms of debate on the issue work best. Whether and how these functions can also be applied in the global context is still an open question, since we do not know empirical example of a truly global referendum involving the citizens of the world. So far, only a few authors develop ideas about how to implement the idea of a referendum on a global scale, given the enormous practical problems of such and

³⁷ In 2006, FSC accounted for the largest certified area with 28% of world forests that are covered by third-party certification schemes (in total 7% of all forests are third-party certified). It is followed by CSA (Canadian Standards Association) with 26% and PEFC (Pan European Forest Council) with 23 % (FSC newsletter, Volume 4, Issue 8 August 31st, 2006). However, needless to say, PEFC and CSA apply much less stricter conditions to be eligible for certification.

endeavor. Stutzer and Frey (2005), however, advocate the idea of a referendum format for the democratic control of international organizations. They propose to institutionalize the direct participation of randomly selected citizens in the decision making of international organizations. This process would include the particular knowledge of citizens who, however, do not necessarily have sufficient information about the issues at stake (while Stutzer and Frey are convinced that citizens would learn the necessary knowledge for their decision making).

Global Activism shows similar scores as the international referendum. However, it is characterized by a form of representation rather than by the open participation of almost every citizen like in a referendum process. It is characterized by inclusive orientation, spontaneity and centralization of decision making. Global activism builds on global organizations of citizens opposing conventional political representation and corporate forms of organization. This can take the form of temporary networks that emerge at the occasion of a particular event — such as the 2000 WTO-Seattle summit (Gillham and Marx 2000, O’Neill 2004) — or it can result in a transnational NGO. In the empirical literature, global activism is seen as largely being based on new forms of communication through the Internet and electronic communication (e.g. Rosenau, 2006). The latter allows for the expeditious and nearly costless diffusion of information on a global scale. It helped to organize protests and to focus attention to specific issues with little costs. This becomes apparent in the case of the debates on the Multilateral Agreement on Investments studied by Deibert (2000). He concludes that the Internet provided the means for local activists to develop knowledge and capacities to form a global movement that exceeds the local and national boundaries. Thus this form of communication was used as a tool for generating knowledge and improving effectiveness of the protest itself. This reflects the core idea put forward by the advocates of global activism, which is to give voice to those individuals and groups that have little opportunity to express their preferences and specific forms of knowledge in other contexts (Della Porta and Tarrow 2005). However, through its partly spontaneous form, this process is selective and not all relevant bodies of knowledge can be included³⁸. Hence, such processes, with low degree of reflexivity, do not allow ranking priorities properly and do not guarantee at all that the attention is focused on the most relevant/urgent issues, neither they ensure that adequate solutions are developed/tested etc. Their main contribution is in introducing a broader variety of political values and interests to international *fora* and, through adding a critical perspective, functioning as a potential correction to government delegations (Nanz and Steffek, 2007).

In contrast to global activism, *emotional collective action* has a even a worse score because of its dependence on the opinion of specific personalities which promote global issues. This means of generating knowledge is deficient with regard to issues and solutions since it gives only some key personalities central roles in the debates and it also inhibits new knowledge to emerge with regard to issues and to solutions-related knowledge. This process is well described by Busby (forthcoming) who studies the role of the Irish singer Bono in the successful debt relief campaign in the year 2000. From this case it becomes rather clear that Bono’s strategic framing of the issue of debt relief as a matter of religious responsibility and well-doing in the face of the 2000th birthday of Jesus Christ was of fundamental importance

³⁸ In addition, global activism builds on the global diffusion through the media. Media attention is a key target of most protest movements, in particular violent forms of protest have a high likelihood of gaining attention by media consumers all over the world (O’Neill 2004). This dynamic particularly focuses on destructive forces; the means of violent protest can hardly be employed for effectively and constructively advance alternative solutions to global problems. Moreover, this form hinders a knowledge generation that focuses on the most relevant issues as perceived by the broader public. The magnetic function of violent media pictures excludes softer and more balanced voice in the knowledge generation process.

for the success of this campaign. This frame particularly helped to convince conservative US politicians to agree to the debt relief for most African countries. The example shows the bias with which emotional activists pursue their case and preclude a more balanced and reflexive process to develop solutions and opinions on issues.

Another mechanism is characterized by strong inefficiencies, while on issues only. The combination of narrow scope, orientation toward exclusive interest and unorganized spontaneous decision — which characterizes the behaviors of *Legal activism* — result in very bad performances on issues and moderately good on solutions. A case in point is the recourse to legal activism by the local “activist NGOs”, who target only particular industrial activity or consumer behavior. The only real contribution of legal activism is on speed for finding solutions, where it even has the best overall score. As stated by Sheila Jasanoff in her analysis of the recourse to “courts based” rule making in the life sciences, this specific mode of problem solving is indeed very popular as a forum for first recourse in social conflicts in the US (Jasanoff, 2002). Indeed, the US courts are among the most democratic ruling institutions, offering relatively easy access to any who claim to have been harmed by public or private conduct. If legislatures are slow or lacking political will, courts offer an alternative route, one of their greatest virtues being that they *must* decide (*Ibid.*). This way of rule making has played a very big role in rule making at the forefront of biological science and technologies. However, there are two main drawbacks. First, this way of rule making is poorly adapted to new and uncertain social and moral problems, as it are essentially the early adopters and users of new technologies who bring their conflicts in the court. Second, judicial decision making occurs in a binary frame – plaintiff *versus* defendant, petitioner *versus* respondent. Needless to say that this mechanism – mainly relying on court suits over infringement of intellectual property legislation over biological materials – has not been able to address more global issues in a systematic matter, such as conservation of biodiversity, which imply a broader dialogue on collective rights and stakes.

Local self-regulation has a similar performance as legal activism, amongst the worst on issues and moderately good on solutions. It has been at the heart of the European Commission’s fifth environmental action plan, which was build around a strategy of ecological modernization (mainly through technological transformation of production and consumption patterns) that would be realized through tools such as Environmental Management Schemes, Eco-labeling and supply chain pressure. Individual countries have adopted similar policies such as reflected in the USA Environmental Protection Agency’s “Reinventing Environmental Regulation” program or the UK safety regime for the North Sea oilrigs based on industry self-management. The assessment of these policies, which have been extensively analyzed, is not entirely positive. Some of the main drawbacks from a knowledge generation perspective are that many of the implementation mechanisms of environmental self-regulation encourage organizations to develop their own environmental targets without consulting any outsiders other than certifiers (Neale, 1997 : 18). For instance, in Europe, environmental groups were excluded from the negotiation and discussions around new voluntary agreements and environmental management schemes of business corporations.

There is a growing consensus that these initiatives only perform well under appropriate governmental oversight in so called regulated self-regulation. Indeed, in spite of this poor quality of the environmental debate that results from this mechanism of exclusion, in some case self-regulation can be an effective way to diffuse knowledge on technological innovations in a cost-effective manner. For instance, under appropriate conditions of transparency and information integration, supply chain and consumer preferences can put

pressure on companies to move towards the best available technology. A clear case of this has been the adoption of more environmental friendly engines by the shipping industry, where environmentally friendly diesel engines developed for power plants in the German market were adapted for ships by a Finnish company having an approximate 14% share of the world market under pressure of the supply chain (Hyvättinen and Hilden, 2004). Another prominent example of successful self-regulation in the field of GPG provision is in the field of reduction of CO₂ emissions. Porter and van der Linde (1995) found, in several instances, that firms developed knowledge to search for innovative solutions. This has been explained through particular inefficiencies and blind spots in the firms' innovation strategies.

The main conclusion we can draw from this discussion of mechanisms with bad performance is again the necessity to combine different types of governance mechanisms. Indeed, some mechanisms have specific strength on a single criterion, but are not performing well from the point of view of the overall performance on issues or solutions.

5 Conclusions

In this paper, we were interested in the global governance of global public goods. We pushed further the idea that knowledge matters and that institutional design should also be thought in function of the cognitive capabilities. We therefore sought to better understand how alternative institutional solutions are efficient in generating knowledge and in ensuring its distribution to make sure that well-informed citizens could take collective decisions.

To analyze how alternative decision/governance mechanisms impact on the process of knowledge generation, we reviewed how the different characteristics of a process of collective decision-making impact on the various criteria of its performance with regard to knowledge generation. Since knowledge about issues is of different kind than knowledge about solutions, because the first is more oriented toward the establishment of (collective) preferences, while the second is oriented toward the search for the most effective (and less costly) ways of addressing these issues, we analyzed the influence of the various characteristics of governance on the two types of knowledge separately.

Generally speaking, when one considers the organizational dimensions that induce the best performances, the three categories of performances request different governance characteristics:

- The best solutions to generate relevant knowledge on issues associate wide scope and inclusiveness. While the best solutions to generate knowledge on solutions rely on the association of inclusiveness and decentralization.
- The best solutions to produce knowledge that is available quickly and widely combine narrowness and organization in the case of issues. They combine narrowness with decentralization in the case of solutions
- The best solution to minimize costs is to rely on processes focusing on a narrow scope, based on exclusive interests and centralized forms of knowledge generation.

It is therefore clear that the design on efficient governance mechanisms should rely on of hybridization among governance principles based, either, on mechanisms combining various logics of decision, or on combination of alternative mechanism in the same process of governance.

When assessing the overall best performances on generating knowledge on issues and solutions, our analysis showed two contrasting effects. First, the scope has a strong influence on the performance of providing knowledge on solutions. Indeed, narrow scope is always to be preferred over wide scope independently of the other organizational characteristics. Second, the best solutions for generating knowledge on issues are characterized by organized decision making, independently of the scope. Finally, the most balanced solutions over the two dimensions are characterized by narrow scope, inclusive orientation and organized decision-making.

Methodologically, the paper advances in building a framework for assessing the trade-offs between quality, relevancy or cost in the overall performance of different governance mechanisms. Two methodological principles come out of this framework. First, the best balanced overall performance is not the result of a linear combination of organizational characteristics on single criteria, but a complex integration of several contrasted effects and trade-offs. There is no direct extrapolation from reasoning on single criteria to a multi-criteria analysis. Second, our analysis has proven to be a good heuristic for discovering and identifying some of the gaps of governance mechanisms that have very good performance over one criterion only. An important challenge that we identified in this context is the need of combining these mechanisms with other institutional frameworks. The particular design rules of these hybrid mechanisms cannot however be known in general, but will depend on their fit with the individual situations at hand.

Appendix

Table A.3
The Relative Overall Performances of Alternative Governance Mechanisms in Knowledge Generation (Section 4)

Scope	Logic of Inter-individual Relationships	Organization of Relationships	Centralization of decision making	Issues +	Issues -	Issues	Solutions +	Solutions -	Solutions	Nicknames (see table 1)	
Wide	Exclusive	Organized	Centralized	10	8	2	7	10	-3	Global Confederation	
			Decentralized	9	9	0	7	10	-3	International Referendum	
		Spontaneous	Centralized	8	10	-2	7	10	-3	Global Self-Regulation	
			Decentralized	7	11	-4	7	10	-3	Global free market	
	Inclusive	Organized	Centralized	11	7	4	8	9	-1	NGOs Coordination	
			Decentralized	10	8	2	8	9	-1	Republic of Science	
		Spontaneous	Centralized	9	9	0	8	9	-1	Global Activism	
			Decentralized	8	10	-2	8	9	-1	Emotional Collective Action	
	Narrow	Exclusive	Organized	Centralized	10	8	2	9	8	1	National Government
				Decentralized	9	9	0	9	8	1	Local Direct Democracy
Spontaneous			Centralized	8	10	-2	9	8	1	Local Self-Regulation	
			Decentralized	7	11	-4	9	8	1	Legal Activism	
Inclusive		Organized	Centralized	11	7	4	10	7	3	Service Providing NGOs	
			Decentralized	10	8	2	10	7	3	Communitarian management organisations	
		Spontaneous	Centralized	9	9	0	10	7	3	Local Activism	
			Decentralized	8	10	-2	10	7	3	Neighborhood Action	

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