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Reflexive Governance in the Public Interest

Global Public Services

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

By Eric Brousseau, Tom Dedeurwaerdere and Bernd Siebenhüner

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Knowledge Matters

Institutional Frameworks to Govern the Provision of Global Public Goods

Eric Brousseau, Tom Dedeurwaerdere and Bernd Siebenhüner

Introduction

The provision of Global Public Goods (GPG) has been extensively discussed in the recent literature. It has been the object of theoretical advances and has increasingly entered political debates both at the UN and at the EU levels. This chapter focuses on the institutional frameworks relevant to generate the adequate knowledge 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 on 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.

The provision of GPG is characterized by several challenges. First, there is no government as a key actor to provide or 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. Second, and this is the particular focus of this chapter, there is a lack of knowledge on the actual needs and solutions. Collective goals are unknown because individuals and communities can form preferences only if they become conscious of the actual stakes dealt with, and of the way they impact on their own individual situations, the situation of others and on future members of the society. Hence this lack of knowledge is not only linked to a revelation problem as in traditional public good provision problems. It 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. Further, solutions are also unknown, both because the relative most efficient means to deal with an issue are unclear and because diffusion of the relevant knowledge is also problematic. 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. development and biodiversity), leading to conflicts among interests that might hinder revelation of information and circulation 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 as the World Social Forum, or even more decentralized, such as in quasi-market solutions as the global carbon emissions market established under the Kyoto protocol. 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. Quasi-markets might play a role when possible technical solutions are available, and when the cost-effective implementation of these solutions is the central issue. However, the latter assume that the goals and collective preferences are well known and the technical and institutional solutions well established. When collective preferences are largely unknown or controversial, and when the solutions are not well established the latter knowledge gaps need first to be overcome. What seems needed in those situations is the broadening of our categories of public debate, through deliberation in

international organizations, but also through more local forms of participatory governance and involvement of communities and citizens in collective learning on GPG issues. Therefore our analysis in this chapter will consider a broad range of institutions and discuss the relative contribution of various mechanisms to the different aspects of the knowledge generation process.

Relevant knowledge on the way to deal with the diversity of global issues is depending upon the scope of the interests actually considered in the decision process, and upon the organization of this decision process to avoid duplication of efforts and boost diffusion, amongst other factors. That's why the involvement of citizens and organized communities in the debate plays a central role at different levels of governance, such as in participatory dialogue, devolved decision-making, local implementation (rather than uniformity), inclusiveness, transparency, information diffusion, collective deliberation, consensus based practices, etc. This claim also 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.

In essence, this chapter seeks to analyze the specific coordination needs in the generation of knowledge on the global problems and the possible solutions to address them, by focusing in particular on the involvement of different types of organized communities at different levels of governance. The chapter is structured as follows. We first 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 (section 2). 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 show how our framework can be operationalized, both to be tested, and to result in real world recommendations. Finally in section 5 we apply our analysis to a set of case studies from the field of environmental governance.

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 frameworks 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 criterion according to which choices in matter of governance have to be made, nor that the performance of the knowledge generation process is the only dimension that matters. In particular, we are aware that governance is a multi-dimensional

process, where efficiency is only one of the central issues. Other issues, such as equity and procedural justice, play an equally important role, as shown for instance in chapter 2 by Inge Kaul. We wish however to push further the idea that knowledge matters, and that institutional design should also be thought in function of cognitive performances.

A Framework to Compare Alternative Decision Mechanisms from a Knowledge Generation Perspective

The focus of this chapter is on the contribution of the alternative regimes of decision making to the generation of knowledge to govern the provision of global public goods. Hence we are interested in solving a public goods problem that is situated at the intersection of two research questions. First, how can governance mechanisms be designed for providing GPGs, in a way which is consistent with the preferences of the citizens, and in a way that takes into account the set of best available solutions for producing and governing these goods? Second, how can governance mechanisms be designed for providing knowledge on these two issues in the most cost-effective way? These questions have been addressed separately in different literatures in the social sciences, but their interface has not been examined in a systematic way. To analyze their relationship, one has to assess the various collective decision making

mechanisms that have been considered in the literature on global governance from the point of view of their contribution to knowledge generation on GPGs. 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 present in this section our basic framework. 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. For that purpose, our approach in this chapter will be based on a total cost approach, in the spirit of Ronald Coase,'s claim to take into account not only the costs of production, but also the costs of coordination. We therefore attempt to assess the relative efficiency/costs performance of alternative knowledge generation processes, taking into account a broad set of indirect costs generated by the creation and functioning of both formal and informal social and political institutions. First, we propose criteria to assess the efficiency and the quality of knowledge generation processes. Then, we categorize alternative processes of decision making (alternative governance regimes) in global governance.

Criteria for Assessing Knowledge Generation Processes

As pointed out 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. 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. In addition, adequacy is understood as a quality of knowledge that is is perceived by actors as relevant — salient in the sense of Mitchell et al. (2006, p. 15) — 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 or new

knowledge (by combination of uncontrollability and cumulativeness). In that respect, for instance, the obligation to disclose publicly either in the scientific world of 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 knowledge.

iv. Fourth, access to knowledge[1] 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 sources of costs differentiate the alternative decision making processes:

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 generating knowledge should be taken into account.

Thus we will assess alternative ways to make decisions 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 efficiently use the available cognitive resources, (vi) to reduce costs of coordination among those involved in the production of knowledge.

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. This distinction is relevant in a national context, where 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). This dichotomy between actors' orientations is also recognized for instance by Scharpf (2000) in his overview of actor-centered institutionalism. As discussed in chapter 1, these alternative principles of orientation and delegation of decision making lead to four models of collective interaction, which have long been recognized in the social sciences (cf. figure 13.1.).

As shown in more detail in chapter 1, 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 the organization of the decision making, leading to 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 fact that individuals are already organized in many types of communities, while the global community is not fully organized yet. There are therefore various types of sub-global communities in which individuals develop their strategies to impact on the provision of public goods in general and global ones in particular. The second is important because of the increasing role of non-state actors in the global arena (Bohman, 2004), and the existence of alternative processes by which either the isolated individuals —

i.e. the citizens — or members/representatives of various types of organized communities interact in alternative decision making processes related to public goods, which leads to various patterns of knowledge generation. The following four dimensions allow us therefore 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 (primarily) 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.

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).

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 spontaneous aggregation of individual choices and from

decentralized adjustments among individuals. Organization increases the efficiency in managing interdependences. Moreover, it leads to accountability of those involved in decision making because as stakeholders or representative of stakeholders (who delegate decision rights to them) the relative role of each of those involved in decision making is clear. When, interdependences are spontaneously managed, a weaker accountability of those who act is to be expected. Indeed, their actual impact on decision is unclear and the relationship between them and the stakeholders is uneasy to establish. Their actions result in facts and information, not in collective choices and organized knowledge

d. The notion of *delegation of the decision-making* refers to the fact that collective decisions are centralized in the hands of a limited number of individuals, or are decentralized in the sense that each individual is able to express voice and impact on decisions. 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 decisions). In the second case, there is neither explicit nor implicit delegation of rights of decision of any kind and the decision making remains decentralized in the hands of the members of the communities).

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).[2]
- Along the *orientation* dimensions one contrasts 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. These decision makers 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. They could also 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.

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 13.1 we show how the combination works, and we provide examples of decision mechanisms, which illustrate these various options in different fields. Note, however, that the column with nicknames in this table does not correspond to "actors", but to processes of decision making. For instance, the third line of this column, nicknamed "global self regulation", should be understood as a situation in which the global regulations will result from knowledge generated through confrontations among groups of interest organized in lobbies dealing among each other on the basis of quid-pro-quo exchange. The fifth line, nicknamed as "NGO's coordination", corresponds to a situation in which the regulation would result from coordination

among nongovernmental organizations promoting their own vision of the collective interest. The nicknames given to each type of governance mechanisms will facilitate discussions of their relative performances later in the chapter. The various examples given in the last column of this table will be discussed in section 5.

[Table 13.1 approximately here]

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 making (presented in section 2.1) impact on the various criteria of performances (proposed in section 2.2). 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 steps[3]: (i) focus and framing of problems and issues (Argyris and Schön 1996, 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 (Voβ, 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 theses steps as respectively (i) "Framework knowledge" and (ii) "Operational knowledge". Since knowledge about issues is more oriented toward the establishment of (collective) preferences than knowledge about solutions that includes 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 3.1 and 3.2 respectively. Sections 3.3 and 3.4 present the conceptual analysis and the first results.

Issues /Framework Knowledge

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 (Schön, 1983). 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 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 incentives of individuals to hide information and ideas since it is not directly linked to the size, but to the other criteria: orientation, organization and centralization[4]. There is also no reason to postulate that individuals would have less incentives 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 because revelation is facilitated (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 capacities 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 decisions 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 leads 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 making is clearly made by a process by which stakeholders explicitly aggregate their individual wishes or ideas. To the opposite, collective decisions can simply result from a process of spontaneous aggregation of individual decisions, 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 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 decisions. 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). The explicit organization of a collective decision making 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 making process favors therefore the revelation/production of knowledge (ii). Second, organized decisions rely on specialization and development of information networks that allows to share information and knowledge. Organization thus 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). Organized decisions are however more costly in terms of coordination (vi), since spontaneous decisions do not request coordination (while it leads to poorer results in terms of genesis of knowledge).

The fact that collective decisions are centralized (and delegated) rather than based on direct interactions/agreements among stakeholders (d) should be neutral on the

adequacy of the generated 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 and 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 making processes and therefore knowledge generation (iii). Indeed, it relies on formal mechanisms to gather information and make decisions quickly. In addition the center can accumulate information and learn, and is incited to develop its capabilities to do so. Also centralization is aimed at reducing costs of decisions (provided they are 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.

Solutions / Operational Knowledge

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 use resources. Decisions 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.

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 is however differences when one considers the issue revelation and speed. The degree of organization of the process of decision should be neutral on revelation 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 as the one highlighted for this dimension of performance in matter on decision/knowledge on issues. Since local adaptation is of high value in the case of the design of implementable solutions, the weight 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 decisions require 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 decisions (d) impacts positively on costs of decisions (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 decisions allow better adaptation of operational decisions. 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 (iv). 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.

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

[Table 13.2 approximately here]

[Table 13.3 approximately here]

These tables help to draw and comment the analytical conclusions of the analysis carried out in the previous section. Indeed, its reading column by column allows analyzing the impacts of the various organizational characteristics on each of our criteria of performance. Its reading line by line allows to identify the principal expected performances of the 16 governance mechanisms identified on the basis of our typology, since each line corresponds to one of these mechanisms. We start first by general comments on the impacts of the organizational dimensions, before

detailing the comparative analysis of the mechanisms. Indeed, our analysis is based on an assessment of performance that is comparative.

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 of the organizational criteria (a to d) on each of the 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 of the 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 type 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 provides, 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 to refine them.

Analysis of the Trade-offs

A first sight, the two tables show clearly that there is no optimal way of generating knowledge on the provision of GPG. Indeed, none of the identified mechanisms is the best on all the identified criteria. A reading of our tables line by line highlights that there are trade-offs 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 knowledge resulting from 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 13.4 and 13.5 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 more 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 that the same dilemma exists 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 performance request different organizational characteristics:

- The best solutions to generate relevant knowledge (i and ii) on issues associate wide scope and inclusiveness. While the best solutions to generate relevant 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 of efficient governance mechanisms should rely on a logic of hybridization among organizational principles based, either, on single governance mechanisms combining various organizational characteristics, or on the combination of alternative mechanisms in the same process of governance.

Comparative Analysis of the Governance Frameworks

The last step in our analysis is to proceed to a "line by line" discussion of the tables with regard to the performance of the 16 cases. The general reading of the table, along these 16 basic governance mechanisms, shows that there is no single best way to generate knowledge on the provision of GPG (see table 13.4 and 13.5 in the appendix). Indeed some mechanisms that are efficient on dealing with issues perform poorly on solutions, and vice versa. Moreover some perform better over some criteria, while being very weak at others. Therefore our categories provide a useful tool to analyze these contrasts in performance over knowledge generation. In the next subsection, we first present some general features of the overall performance

of the different mechanisms, before turning to an application of our framework to a set of case studies from the field of global environmental governance.

Our analysis leads to point out how the 16 basic types of governance frameworks, resulting from the combination of the principles for organizing collective decision making processes, lead to contrasted results in generating knowledge on issues and solutions. The following figure sums up the results of our analysis for these different governance frameworks. For each of the mechanisms we added-up the evaluation of the performance over the 6 criteria presented in the table 13.1 and 13.2. This results in a comparative ranking of each of the mechanisms on a scale from -2 to +2 over issues (on the horizontal axis) and solutions (on the vertical axis) respectively.

[Figure 13.1 approximately here]

We will group the basic types of governance mechanisms in four clusters, to facilitate the discussion on the general findings of the comparative assessment. Each cluster groups mechanisms with similar organizational characteristics and similar performance in knowledge generation on issues or on solutions: community based frameworks (best over solutions), national and local democracy (moderately good both on issues and solutions), global organized debates (best over issues, poor on solutions) and spontaneous markets like coordination (worst on issues, while being bad or only moderately good on solutions). Based on these distinctions, we first discuss the cluster of global organized debates, because these have been most

prominent in the debates on global governance. Then we turn to the clusters that show best overall balanced assessment over issues and solutions, which are the community based frameworks, and national and local democracy. Finally, we highlight some of the features of the spontaneous market like coordination mechanisms, which in comparison have the worst performance over issues or solutions. The more detailed overview discussing the knowledge features of each of the mechanisms separately is given in the table 13.6 in the annex.

First of all, our results confirm the positive performance for generating knowledge on issues of global organized debates. Indeed, the cluster of mechanisms which are wide and organized are the best performing over issues. This is the case for NGOs coordination, republic of science and global confederation. The case of global direct democracy, which is also global and wide, only performs moderately well on issues, which is mainly due to the high coordination costs. The case of the NGOs coordination has the overall best performance over issues in this cluster. This result is especially relevant because of the prominence of this mechanism in global governance, such as in the important role of the Intergovernmental Panel on Climate Change which we will discuss in more depth below.

The main weakness of global organized debates is the general poor performance on knowledge over solutions. This weakness is also amongst some of the major concerns that have been raised in the assessments of global debates in the literature. Key

problems related to this weakness are the difficulty to involve citizens and communities in the debate over the more operational aspects of possible solutions for GPG provision and the difficulty of global debates to integrate the diversity of collective preferences that play a role on the national level when implementing the global agreements. Lower level governance units, which also involve national governments, citizens and communities in the debates, hence seem also relevant for the problem of GPG provision, especially because they show better performance over solutions.

Our analysis shows two clusters of mechanisms that perform overall balanced performance over issues and solutions. The first is the cluster of community based mechanisms in the upper part of our figure, which are based on the involvement of the local communities and citizens in the debates over GPG. These are the service providing NGOs, the community management organizations, local activist networks and neighborhood action. These mechanisms all perform amongst the best over solutions. The community management organizations and service providing NGOs are particularly interesting, because they also are amongst the best on solutions. Therefore they are representing the most balanced governance mechanisms when assessing them over the two dimensions at once. The second is the cluster of mechanisms based on national and local democracy, which are the two mechanisms that are usually addressed in pair with the global mechanisms in the literature on

multilevel governance. They are both exclusive and their main strength is the efficient use of cognitive resources and the speed of the cumulative knowledge generation process. They perform rather weakly on revelation and adequacy when compared to the global debates, but overall show a balanced performance. They are moderately good at issues, while having a good performance on solutions.

Finally our results also show the weakness of spontaneous mechanisms for generating knowledge on Global Public Goods. The group around market coordination mechanisms for organizing the debate, based on exclusive interests, performs amongst the worst on issues generally. This is the case of the global free market, global and local self-regulation and legal activism. The group of global spontaneous and inclusive mechanisms, which are the emotional collective action and global activism, perform badly both over solutions and issues. They are not organized for structured cumulative knowledge generation and generate major inefficiencies in the use of cognitive resources. The only spontaneous mechanisms that perform comparatively well are the local and inclusive mechanisms which we discussed above, the neighborhood action and the local activist networks. The latter's strength on solutions comes from the proximity of the direct user communities and stakeholder groups concerned with GPG, which is a major incentive for proving the effectiveness of the solutions in a way that is directly fine tuned to the specificities of the different contexts.

Case Studies on Biodiversity, Climate Change and Sustainable Development

In this section, we apply our theoretical argument to a set of case studies from global environmental governance, taken from the implementation of the conventions and action programs that came out of the 1992 Rio Summit. The Rio Summit was characterized by major innovations in global governance, the most prominent of which was the massive participation of civil society organizations, international federations and other non-profit associations in the debates. Further, after the Summit, new organizations for more systematic knowledge gathering were created, such as the Multi Stakeholder Forum of the Commission on Sustainable Development. Therefore, the Rio Summit and its subsequent implementation provide an appropriate collection of cases for applying our argument.

Three conventions, the UN Framework Convention on Climate Change, the UN Convention to Combat Desertification and the Convention on Biological Diversity, as well as an action plan on sustainable development, the Agenda 21, were the main outcomes of the Rio Summit. The issues of climate change, biodiversity and sustainable development all are issues characterized by intense debates, conflicting and often absent collective preferences and high uncertainty on the knowledge for the most appropriate solutions. As a consequence one of the main challenges for global environmental governance in these fields is to build better knowledge on the

problems and the possible solutions and to build and reveal the collective preferences.

Finally, we discuss the cluster of governance frameworks that comparatively perform the worst, which are the spontaneous organization of debates around market coordination and global activism.

Case Studies on Global Organized Debates on Climate Change

We will first discuss some of the most prominent frameworks envisioned to deal with the challenge of knowledge generation, which all have implications for the organization of systematic knowledge generation through global debates. This was for example the case in the Climate Change Convention, through the creation of the Intergovernmental Panel on Climate Change, which we will discuss first, or in related initiatives such as the Earth Systems Science Partnership and the Multi-Stakeholder Forum in the Commission on Sustainable Development. We will refer to these cases in order to discuss the first cluster.

The Intergovernmental Panel on Climate Change (NGOs Coordination) The Intergovernmental Panel on Climate Change has gained significant prominence in the field of international climate policy. With the Nobel Peace Prize awarded to the IPCC in 2007, the panel's activities as a knowledge generating mechanism were

widely acknowledged as effective and forceful in climate and even peace policies (Alfsen/Skodvin 1998; Siebenhüner 2002). Within the framework advanced in this study, the IPCC can be analyzed as an *NGO coordination* mechanism which is characterized as a centralized process that is well organized through a number of rules of procedure. In addition, the IPCC is inclusive with regard to the scientists involved since it strives to include almost all relevant climate scientists in the drafting or review process of the reports. It is also a wide and globally organized process which has been launched in 1988 by a joint initiative of the World Meteorological Organisation (WMO) and the UN Environment Programme (UNEP) to address the truly global problem of climate change.

The IPCC's central objective is to assess the current state of knowledge on climate change, to condense it into reports that are reviewed and approved by scientific reviewers and governmental experts. It has been designed as an intergovernmental organization that is basically scientific in its membership but involves governmental participation in the process of approval of the major conclusions. Since its beginning, the IPCC has produced four major assessment reports (concluded in 1990, 1995, 2001, and 2007) and a sizeable number of special reports and technical chapters as well as supporting materials such as guidelines and documentary material (see www.ipcc.ch). In particular the 2007 report has been widely recognized in public

media and public debates. Even political outcomes such as a decision by the heads of state of the G8 in 2007 and the EU can be linked to the findings in this report.

With regard to the *adequacy* of the knowledge generated in the IPCC processes, one finds that the outcomes of the processes are focused on the specific issues at hand, but are significantly limited in generating solutions-oriented knowledge. The IPCC assessment reports are organised in three working groups that focus on the science of climate change (Working Group I), impacts and adaptation to climate change (Working Group II) and mitigation options (Working Group III) with highly separated processes. While the first group is dominated by physicists and atmospheric chemists, it is biologists, geographers and ecologists that form the core of the Working Group II team. In Working Group III, it is mostly economists and political scientists who analyze the policy instruments to reduce CO2 emissions. Over the past four assessment reports the products of Working Group I has gained the strongest acknowledgement and attention in the public debates. The report presents recent research about the actual changes in the climate system and the rise in global mean temperature and sea level rise. This knowledge relates to the problem dimensions and its characterisation rather than to solutions. By contrast, solutions-oriented knowledge can mostly be found in the report of Working Group III that traditionally is the most contested among the three Working Group's reports. Since this part directly addresses governments' decision making and clear measures to

achieve ambitious policy goals, governments were critical about the work of this group. In addition, different ethical and paradigmatic positions among the authors involved furthered a tendency towards the lower common denominators. The contestation among scientific and in particular among governmental experts lead to weak formulations and the strict verdict to describe policy options rather than being policy prescriptive. In contrast to most national or other global assessment processes such as the Global Environment Outlook, the IPCC's Working Group III report refrains from any clear suggestions or recommendations for the international negotiation process or for domestic climate policies. It merely restricts its report to the description and analysis of possible policy instruments. In this respect, the case study illustrates well the scores for the case NGO coordination in our theoretical framework where the results for issues-related knowledge are significantly better than for solutions-oriented knowledge.

The IPCC reports provide the most comprehensive compilation of climate related knowledge and is thus well equipped with regard to *revelation*. It is the objective of the IPCC since its establishment in 1988 to bring together the existing and most advanced knowledge on climate change. So far, this has mostly been restricted to scientific knowledge, but in particular Working Group II increasingly opens up for non-scientific sources of knowledge such as local and lay knowledge on climate impacts. The inclusion of up to 1500 climate scientists into the drafting process of the

reports ensures a broad representation of scientific research fields and findings. In past years, the IPCC even deliberately involved outspoken sceptics of climate change in the process. Thereby, their arguments and findings had to withstand the critical discussion among colleagues and were in most cases not sufficiently convincing, as the Fourth Assessment Report, published in 2007 shows (IPCC 2007). In addition, the quality assurance process of a two-tier peer review including reviewers and review editors select the most relevant and well-grounded knowledge for the purposes of the reports (Edwards/Schneider 2001). This knowledge generation process can thus be viewed as rather good in revelation.

As far as *speed* of knowledge generation is concerned, the IPCC must be regarded as a rather slow process. It publishes its reports every five to seven years which prevents its reports from generating a direct influence on international negotiations with its annual conferences of the parties. It is only through its specialized technical reports that the IPCC can react to short term and immediate political information needs in particular fields such as greenhouse gas emissions through aviation. The gap between political decision making processes and the IPCC's knowledge generation has been addressed by the formulation of guiding questions by the conference of the parties to be answered by the IPCC. However, the IPCC was only able to deliver its synthesis report that explicitly responded to these questions almost five years later. This long time span can be explained through the lengthy process of

drafting, reviewing and approving the reports and its summaries for policy makers. In addition, IPCC members maintain that shorter reporting intervals are useless since the scientific debate will not have enough time to come up with sufficient new findings that render the effort of a new report worthwhile. Slowness of the IPCC process is thus a structural problem of this knowledge generation process.

Accessibility of the IPCC process has to be seen as twofold. Firstly, the drafting process of the IPCC reports is characterized by strict limits to access for external individuals such as journalists or NGO activists. Until the official publication date, IPCC members are obliged not to forward any information about the contents of the reports to externals. Through the review process and the governmental approval mechanism, changes in the contents and the overall thrust of the reports are likely throughout the process and the IPCC Secretariat watched carefully that no information leaked before the well-orchestrated public event for the publication of the reports. Secondly, after the reports have been published, it is the ambition of the IPCC to diffuse the knowledge as widely as possible to various audiences. In this phase, broad accessibility can be observed. However, the reports themselves mostly address scientific audiences. They are written in scientific language and strive to gain large credibility within the scientific community. However, each Working Group summarizes its findings in summaries for policy makers that are intended to reach decision makers, the media, NGO representatives and interested parts of the larger

public. Through the publication of its reports and the summaries for policy makers in the internet and in printed form, the IPCC attempts to diffuse its products as widely as possible.

IPCC reports only collect and assess existing knowledge and do not report on original novel research itself. As an assessment report, it does not conduct research except for conceptual advancement and model simulations within its scenario-building exercises. In this respect, the IPCC is at least in parts a *duplication of efforts* if viewed on a macro-economic scale. It duplicates the research findings that are already there and published in other forms and outlets.

Coordination costs are rather high within the IPCC process. All 1500 authors and reviewers need to be coordinated and large numbers of them even have to travel to common meetings. However, this coordination facilitates the exchange among researchers and brings together their individual research findings. This helps in fostering international exchange and in limiting other coordination efforts, e.g. at international conferences or alike.

The Earth System Science Partnership (Republic of Science) The Earth System Science Partnership brought together four formerly separate international research programmes active in the field of environmental sciences. It was in 2001 when the World Climate Research Programme (WCRP), the International Geosphere-

Biosphere Programme (IGBP), the DIVERSITAS Programme on integrated biodiversity research, and the International Human Dimensions Programme on Global Environmental Change (IHDP) came together to join efforts. They acknowledged the fact that the available knowledge on the ongoing changes of the entire earth system need to be brought together to understand the systemic developments and interlinkages between the subsystems such as the climate system, the biosphere, the oceans and the socio-economic processes. It is thus the overall aim of the ESSP to facilitate the exchange of knowledge among the different subprojects and to concentrate research efforts on particularly challenging developments or issues such as the global carbon and climate system, the food system and water provision. All sub-programmes are platforms for scientists active in the field that coordinate larger research endeavours and communicate between scientists and funding agencies. Core activities of the programmes are structuring of the related research fields into core projects, the formulation and publication of science plans for these fields, the organisation of related research activities, conferences and the exchange with funding agencies.

The ESSP serves as an example for the republic of science that has been characterized as wide, inclusive, organised, and decentralized. It is wide in it scope since it has a global reach in its membership structure and the composition of its central decision making bodies. Moreover, the topics covered by the individual programmes and the

issue of earth system science as such are global and focus on the earth as a whole. The ESSP is inclusive inasmuch as there are no strict limitations to membership and all researchers that have an interest in the field are allowed to participate in the ESSP activities. There is no official membership for researchers in the different programmes; their affiliation to the different programmes builds on voluntary self-ascription on the basis of their research interests and activities. While membership patterns are loosely defined, the Programmes, however, have clearly set governance structures for their decision making. They can be understood as organized since they form scientific committees, planning groups and alike for granting credibility and legitimacy. The partnership is loosely centralized since there is only a weak central coordination unit and most research activities are conducted and coordinated de-centrally. Even the individual sub-programmes are organized in a de-centralized structure with various administrative units and coordination centres for the core projects and other cross-cutting activities.

As a knowledge generating process, the *adequacy* of the ESSP's knowledge can be described as good in bringing up issues and in analyzing problem dimensions. However, it is weak with regard to solutions. Its programmes concentrate on original research that is related to understanding the functions of the earth system and the influence of humans in this interaction. However, solutions-oriented research is almost absent in all programmes except for the IHDP where human actors are being

analyzed with regard to their ability to solve global environmental problems. Thus documents produced by the ESSP are mostly analytical and rarely address solutions, nor do they formulate policy recommendations or alike.

Within its network, the ESSP is open to reveal the knowledge among the members of the individual projects. However, the exchange between different programmes and between individual core projects remains limited within ESSP. So far, knowledge generated in the individual projects such as the Global Carbon Project or the Global Food Project is only revealed and widely shared at the occasion of larger conferences organized by the ESSP and its sub-programmes. In particular, the link to the policy world is difficult for the programmes and few of the projects have well developed science-policy interactions or a wide audience in the policy realm. In contrast to the results of our conceptual considerations, revelation is thus much more limited than expected. This can be explained by the fact that the ESSP is not a pure case and is in parts centrally organised. This central coordination tends to select and focus knowledge flows in parts and reduces the revealed knowledge.

In addition, the ESSP processes are comparatively slow. Most of its core projects operate in longer time horizons of about 10 years, such as the core projects of the IHDP. A full project cycle starts with the formulation of a science plan that formulates central research questions and describes crucial avenues for the research in the field. The drafting, review and adoption process of a science plan usually takes

about 1.5 years before the project itself is officially launched. In this process, scientists and a few policy makers are involved. In the following years, researchers are called upon to contribute to answer the questions through individual research projects. In addition, science plans are communicated to funding agencies to raise interest and give impulses for the formulation of funding strategies. After 10 years, the final results of individual research projects are to be presented and synthesized with regard to the overall research questions.

Documents produced by the programmes and the projects under the ESSP in general address scientific audiences which reduces their accessibility for non-scientists. Most publications appear in peer-reviewed journals or with scientific publishers. Only few publications such as press releases, short reports in bulletins or information brochures focus at non-scientific audiences. However, most affiliated projects and programmes actively try to increase access to their documents through the means of the internet, of chapter series, short movies and educational programmes on the respective issues.

Duplication of effort can be observed only in a few cases within the ESSP when individual projects conduct similar research without knowing each other. Given the large number of researchers involved and the loose coordination within the ESSP at large, duplication is possible, but not systematically build into the system. It is the central objective of the partnership to facilitate exchange among scientists and,

thereby, to induce communication and reduce duplication of similar experiences. In particular, cross-cutting projects have been developed to provide space for the common exchange about similar experiences and similar research topics such as governance and social learning within the IHDP context.

Coordination is much more an effort for the ESSP due to the large network and its loosely integrated structure. In particular when compared to the IPCC, the ESSP has less clearly structured procedures and open membership patterns. This reduces the immediate efforts to coordinate among the central bodies, but creates problems and larger coordination problems among individual researchers and individual projects under the ESSP.

The Global Environment Outlook (Global Confederation) The Global Environment Outlook (GEO) published by the UN Environment Programme in 2 to 5-year interval provides a case for a global confederation as knowledge generating mechanism (UNEP 1997, 2000; UNEP 2002; UNEP 2007). It gives an overview of the environmental problems of the world and formulates directions for future policy action in fields of particular need. With this objective, it is global in scale, even though it is structured according to world regions with their different problem structures and policy challenges. The reports are drafted by a limited number of researchers and UNEP staff located in the different world regions. In addition, UNEP

and its experts strive to include external expertise into the process of drafting the chapters and in the review process. While the core authors invite other scientists in regional workshops to articulate their view and to bring them into the report, a larger number of external experts are approached to review and comment the final drafts of the report. However, when compared to the IPCC the number of authors and reviewers involved is significantly lower; it is about 200. These authors include scientists, experts nominated by governments, policy practitioners, and representatives of UN organizations. As a process that is governed by a mandate from UNEP, the preparatory team is not free from the exclusive interests of national governments represented in UNEP's Governing Council.

The knowledge generation within the GEO process can be seen as well organized since it consists of a well-defined sequence of consultancy workshops with governments and other experts to identify crucial questions and information needs in the policy world, followed by intense drafting and assessment work by the authors and the review and publication process. It is also centralised since UNEP serves as the focal organisation that pulls together all contributions and regional chapters and brings it into one document.

UNEP's Global Environment Outlook provides a comprehensive insight into the most pressing environmental problems on earth and provides directions and policy options for policy makers. It is a document that contains adequate knowledge not

only for policy makers but also for NGOs, scientists, interested individuals and open-minded business representatives. While it has been considerably effective in bringing up specific environmental problems and needs for action, the GEO reports also contain stronger statements for political decision needs. They clearly mark their key messages and apply a much stronger language with regard to solutions and required political actions that the IPCC documents. Like the IPCC reports, also the GEO reports avoid to formulate policy recommendations. However, the more exclusive structure of the GEO when compared to the IPCC seems to render the process more apt for stronger words towards the policy world than the highly inclusive and consensus-based IPCC process. While the smaller number of authors than in the IPCC process provides for a more focused writing process, the drafting process reveals less knowledge itself than in the IPCC case with its large number of authors for each chapter.

The first three GEO have been published within about 2 year intervals which provided for a comparatively expeditious assessment process. The speed slowed down between 2002 and 2007 when almost five years elapsed between GEO 3 and GEO 4. Whereas formerly, the process could have been characterized as fast, it is open whether the speed will increase again in the future. With a 5-year interval, the GEO will fall into the same problems as the IPCC with its long delayed responses to policy needs and questions formulated several years ago.

The GEO documents are well accessible for all interested groups. They are not only written for scientific audiences but also for informed lay citizens, policy makers and other interested people. In addition, they are broadly made available through the internet and book publications, as well as a short version particularly aiming at children. This level of accessibility contradicts in part the findings from our conceptual framework which expected lower accessibility due to the exclusive character. However, the partly inclusive character of the UNEP process and the deliberate mandate of UNEP to raise awareness for environmental problems support activities to increase broader access to the documents. Due to its centralized structure, the GEO process has little duplications. It is through the well coordination among regional centres and the central GEO office that experiences are shared and that new methods or other general questions can be diffused quickly among collaborating teams.

Coordination only entails moderate costs since the structure of regional GEO offices is already in place. Since UNEP is able to steer the process under its own authority, no further coordination with other agencies or state delegates is necessary in the GEO process. Nevertheless, the network of GEO collaborating centres requires some maintenance efforts and funding. Costs are thus not nil.

The Multi-Stakeholder Dialogue in the Commission on Sustainable Development (Global Direct Democracy) The Commission on Sustainable Development was set up after the 1992 Rio Convention to implement the objectives of Agenda 21, the action plan for implementing sustainable development through global, national and local initiatives. In 1997 the multi-stakeholder dialogue (MSD) was set up as a unique participatory model that allowed to engage major groups and governments effectively in a global dialogue on specific sustainable development issues. In 2001 a total of 3000 organizations (and thus so many more individual representatives) were accredited an observer status, with the right to participate in the meetings of the CSD, to submit written statements at their own expense and to set up informal set events and meetings at the discretion of the chair. A similar mechanism for involving NGOs in the global debates has been set up in the case of the climate change debates that we discussed before, through the direct accreditation of NGOs as observers in the UN Framework Convention on Climate Change. However the MSD has some real originality because of the more structured nature of the different stakeholder dialogues.

In the overall assessment, the MSD shows rather weak performance in contributing knowledge generation on GPG, even if it has some strength in the revelation of issues. The different NGOs tend to compete for attention and access to the decision making arenas (Mori, 2004). In particular, established NGOs attempt to exclude

newcomers to be part of the process, because it might decrease their influence. Moreover, the different NGOs and associations have very different objectives in participating in the forum, ranging from lobbying by business associations in their private interests to more open exchange on issues of general interest in order to find common ground. All this leads a rather weak contribution to the building of more adequate knowledge. The complexity of the process and the competition between the different organizations also has a negative impact on the speed and accessibility, which is generally weak. Indeed it weakens the rapid delivery, exchange and dissemination of the produced knowledge.

The main strength is the capacity to reveal new knowledge on issues. The NGO involvement in the MSD is a highly organized process and aims at the highest possible representativeness. Equal participation of issues and regional networks is ensured by the steering group. Hence a lot of new knowledge can be brought to the attention to the decision makers and the MSD has been assessed as a unique way to involve major groups in reviewing the progress that is made on sustainable development in the different member countries of the Commission on Sustainable Development. However, the propositions made at the MSD are not guaranteed to be included in the chair's summary. Hence the connection with final decisions remains weak.

The weakest performance of the MSD is on the level of the cost-efficiency of the knowledge generation process. The MSD is a very costly process, compared to the actual progress that is made on building the knowledge base and revealing the collective preferences. Especially the coordination costs amongst a heterogeneous set of organizations with different capacities and levels of expertise are very high. The MSD however realizes some gain on the duplication of effort, by improving the communication around the identification of problems that are encountered with the implementation of sustainable development in the different member countries.

Case Studies on Multilevel Governance for Sustainable Development

The global debates discussed in the previous section have been criticized for their weakness in dealing with major differences in national collective preferences and for excluding non-profit organizations and citizens from the effective decision making and the more operational phases of the implementation. Multilevel governance frameworks involving national and local democracy and community based frameworks have been proposed as alternative approaches and we discuss how they would be able to cope with these criticisms. These have lead to contrasted performance in terms of knowledge generation. We discuss some of the most prominent experiences and assess their contribution in the terms of our analytical framework.

Local Agenda 21 (local direct democracy) The agenda 21, which has lead to the multi-stakeholder process at the international level in the so-called multi-stakeholder dialogue under the CSD that we discussed above, was conceived from the outset as a multilevel initiative. Therefore it had an important local component, which is generally considered as a second major innovation of the Agenda 21. Through this local component, Agenda 21 is one of the rare international processes addressing governance also at the local municipality and community level. One of its goals is the direct involvement of citizens and citizens' groups in the decision making on sustainable development. As such this innovative process is a good illustration of a systematic attempt to organize local direct democracy.

There has been a fairly broad response to the call for local initiatives under Agenda 21 (hereafter the LA21), the blueprint for implementing the concept of sustainable development agreed at the Rio Summit in 1992. A case in point are the LA21 in the UK, which have spread quite widely, such as the local biodiversity action plans, as being part of the reform of the drafting process of the UK National Biodiversity Action Plan. In general, the LA21 processes gather all the relevant stakeholders of a certain area, in order to draft a strategic plan of sustainable development of the area, including an assessment of the environmental, social and economic components of sustainable development. Here we discuss one particular case, which is the case of

the LA21 in Norwich, a small rural town of around 130.000 inhabitants in eastern England (O'Riordan, 2001).

The adequacy of the knowledge produced under the LA21 in Norwich has been very much criticized. Indeed, very much of it reflected the contribution of the different vested interests, especially the local authorities, which framed the process in terms of the need of continued and reliable economic growth, rather than sustainability per se. Some of the environmental issues were taken into account mainly through the heading of "quality of life", such as reduction in traffic in the city center and through preserving the city's heritage. The process did therefore only highlight a narrow range of issues.

However the LA21 process had a positive impact on generating more cumulative knowledge acquisition and improving the access of the citizens to the public deliberation and the information on the local development. For instance, the LA21 multiplied the number of opportunities of deliberation on sustainable development, even though narrowly framed. Thematic round tables have been set up on transport and city life amongst others, citizens' juries have been held and a development association created. Moreover, the LA21 action plan has been reviewed each year through the development of sustainability indicators and through an annual conference where progress is reported, assessed and new issues are raised. Overall it

can be said that the LA21 has increased the speed and the accessibility of the knowledge generation process.

It is difficult to assess the cost-efficiency of the process. The LA21 has not been generalized to all the issues of the public administration and is largely considered as a pilot project. For areas of development where different stakeholders are running similar initiatives, such as estate regeneration projects, the LA21 has lead to more focused investment of urban regeneration money. In other areas, however the process increased social conflict without being able to provide solutions.

The United Kingdom Biodiversity Action Plan (National Government) National initiatives are also one important component of the multilevel framework envisioned in the agenda 21. An example of such national government initiatives are the national biodiversity action plans. A case in point is the United Kingdom Biodiversity Action Plan (UKBAP), which has been gathering in a systematic way since 1994 data on species and habitats in the UK and developing target based action plans for these. It has been referred to as a prime example of a modernist (reductionist and rationalist) approach to environmental management (Adams 1997) and as such reflects well our category of centralized and organized governance devices.

From a knowledge generation perspective, the main drawback of the mechanism is the adequacy of the knowledge produced on GPGs. Indeed, the UKBAP adopts a

more narrow view focused mostly on separate species and habitats which can easily be reported by individual knowledge providers and reflect the local concern of the different contributing partners. This is in sharp contrasts with the ecosystems approach promoted by the international epistemic communities and the initial, more holistic approach, of the UKBAP to biodiversity as being composed of highly interdependent entities and interconnected levels of organization.

Revelation of new knowledge is also relatively poor, even if in the long run, knowledge accumulation starts to produce its effects. In the first major update after 10 years, the list of species has more than doubled, because of the increased capacity to systematize new knowledge based on previous contributions.

The speed of the overall process was rather good. The initial capacity of the UKBAP to rapidly centralize already existing knowledge on species and habitats was relatively good, even if access to the knowledge was not always easy. In two years time, between 1994 and 1996 a relatively robust list of species and habitats that deserved attention was produced and updated every 3 years. The adjustment on the appropriate action plans however took more time. In a lot of cases, the actions actually written down were not actually the appropriate actions to take and the UKBAP because of its formal centralized and politically representative process was not able to integrate rapidly grass-root experience with the targets. This has lead in

2006 to calls for increasing the linkages amongst different levels of decision making and further reform.

The main strength of the UKBAP has been to effectively coordinate amongst a wide range of individuals and organizations, including experts, and both government and non-government organizations. Moreover it increased the efficient use of the available knowledge by producing a single reporting system able to deal with very long lists of species and habitats. This has been a major improvement over a situation composed of a veritable cottage industry of single species NGOs competing for public attention. In sum, in its knowledge production, the UKBAP process has allowed to make important progress in principal activities: prioritization (of species and habitats), planning (of targets and activities) and monitoring (of inputs and achievements of targets). These progress in turn have helped to frame and consolidate the more local dispersed initiatives of environmental associations and community organizations on biodiversity monitoring and assessment.

Case Studies on Community and Citizen Involvement in Use of Natural Resources

The third cluster considered in our framework is the cluster of community based frameworks. These perform amongst the best on generating knowledge on solutions, but show contrasted performance on issues. We will illustrate the four types of mechanism in this cluster, by first discussing the service providing NGOs and the

community management organisations, which are characterized by an explicit organization of the decision making and show the best comparative performance. We then focus on the mechanisms based on spontaneous citizen involvement, which show much weaker performance on generating knowledge on issues.

Carbon Compensating Agencies (Service Providing NGOs) A recent form of centralized local activism are service providing NGOs. For instance, in the past years a number of agencies emerged that offer carbon offsetting services in particular for air travel.[5] These agencies run projects to avoid carbon emissions or buy certified emission reductions according to the clean development mechanism of the Kyoto Protocol under the UN climate convention. Many of them come from a NGO background or are still run as an NGO. Since they offer these services often only to citizens or companies from particular countries their scope is generally narrow. However, due to their often non-profit business model they attract many customers to achieve their goals of increased CO2 reductions. This renders them inclusive and organized in the sense of our theoretical framework. Moreover, their mode of operation is usually centralized in one or a few locations from where operations are managed.

In the categories of the theoretical framework, this case provides an example for an effective knowledge generating process, even though so far little systematic research

has analyzed these processes. As expected from the assumptions of our framework, this particular case is generally very good in providing adequate knowledge on solutions, e. g. on ways how to organize travel in a more carbon friendly manner. In addition, these agencies necessarily have to find new solutions to compensate CO2. However, the generation of knowledge and awareness on issues falls barely into the responsibility of these agencies. They attempt to raise awareness for the problems of carbon emissions through air travel, but have little effect on advancing knowledge on this issue as such.

With regard to revelation, these agencies are generally open in publishing knowledge on their projects and on the problem of climate change and air traffic. They use the internet to raise awareness for issues of climate change and to promote solutions to compensating CO2 emissions. They have an essential interest in promoting their solutions on their compensation measures. However, due to increasing competition between these agencies, some details of the implemented solutions are generally not being published.

The speed of the knowledge generation and diffusion is rather high since most agencies heavily rely on the internet and post all relevant information on their websites. It is in their business interest to have information about new solutions and

potential new knowledge on the problems of climate change and air traffic in the public domain as early as possible. By the same token, carbon compensating agencies provide information and data that is accessible for the broader public and not exclusively for experts. As inclusive mechanisms, it is their interest to broadcast this knowledge as widely as possible. However, some details of the compensation are usually rather technical and bureaucratic and are difficult to communicate to their customers.

Duplication of efforts among carbon compensating agencies in the generation of knowledge on solutions is generally low. The agencies cooperate with similar projects that are often comparatively transparent. The calculation algorithms for assessing the necessary amounts of CO2 compensations are publicly available. Coordination costs are also still rather small, but worldwide links to carbon-compensating projects require some coordination efforts in the generation of knowledge.

Kristianstad Watershed (Community Management Organizations) A more decentralized form of community and citizen involvement, which is especially relevant for global public goods such as climate change mitigation and biodiversity conservation, is the provision of ecosystems management services through collaborative management organizations. A case in point is the Kristianstad

watershed in Southern Sweden (Olsson et al., 2007). The Kristianstad watershed is one of Sweden's most productive agricultural areas and also contains one of the largest groundwater reserves in northern Europe. The abundance of valuable ecosystem services generated in the area is also reflected in the range of stakeholders representing different interests, from local farmers to international nature conservation organizations. Since 1989 a collaborative approach to management has been in place in part of the watershed, which evolved into the adaptive co-management system of the broader Kristianstad Vattenrike Biosphere Reserve (KVRB). This system relies on a social network of concerned individuals and organizations and a multi-member organization, the Biosphere Office, which plays a key role in facilitating and coordinating the collaborative process to maintain the ecosystem services of the area. In particular the Biosphere Office has been able to facilitate information flows, identify knowledge gaps and create nodes of expertise of significance for ecosystems management.

With regard to the adequacy of the knowledge generated by the collaborative governance in the KVBR, the inclusion of a broad range of organizations in the social network and in the Biosphere Office lead to take into account global public good aspects, even if the scope of the governance device is local management of the watershed. Through the networking of a set of existing organizations and actors, the learning process was able to produce a set of cross-cutting concepts, such as

landscape management, that better reflected the mix of local and global issues at stake.

The main strength of the decentralized collaborative mechanism resides however in its capacity to enhance revelation of and accessibility of relevant knowledge. In particular, the role of the Biosphere Office in revealing new issues that are important for the entire watershed was important. It operated through involving previously disparate players such as nature conservation associations and farm related organizations in a collective decision making process, organized around clusters of topics of common concern. Further, the local focus allowed developing some context specific solutions, such as means through which bird watchers and farmers can coexist in some popular bird-watching areas through joint monitoring of bird presence and various activities to minimizing crop damage.

One of the weaknesses to be addressed are the high coordination costs induced by the decentralized nature of the mechanism and the slow speed of the learning process due to the need to manage a complex set of independencies amongst the actors. Some of the cost problems have been mitigated by relying on several funding sources for the Biosphere Office, including the municipality and regional and national authorities. The speed problem has been addressed through creating so-called "adhocracy groups" which are spontaneous organizations that emerge from the social network and can take over some of the collaborative efforts, triggered by

exogenous events, such as the arrival of migrating cranes or extreme floods. However these groups have never been at the core of the collaborative watershed management, which was more organized from the outset. It is also an example of such ad hoc local activist networks that we turn next.

The Danish Windmill Industry (Local Activist Network) An appropriate illustration of the contribution of a local activist network to knowledge generation is the case of the role of the Danish windmill industry in the field of renewable energy (Smith 2006). Danish windmills have been developed in the 1980ies by a network of local activists with the help of farmers and was given economic sustainability by selling electricity through local cooperatives. Lessons learned through years of user involvement in testing of designs in techniques lead to major improvements. The success of this innovation is illustrated by the fact that today the knowledge produced in these local networks has been taken up by the national government and major private corporations. As a result, the Danish windmill industry has grown out of its initial grassroots and has become a world leader in the sector.

In the initial years, the knowledge on the windmills was created through individual activists who favored a niche-based approach to sustainable development by operating in local farmer communities and which networked together for the exchange of knowledge. In terms of our framework it is an example of a centralized

process, because of the important role of the network of leader-activists which centralized the available knowledge on technical issues and on social feasibility. However, because of the absence of an explicit mechanism of decision making on the knowledge production it can be characterized as a spontaneous process. Even if the activists were oriented towards the collective interest, there was no explicit decision making process to create social accountability for their specific approach to sustainable development.

The adequacy of the produced knowledge is difficult to assess. Indeed, even if the inclusive character of the process allowed to gradually improving the technology performance for users, the process remained narrow in character, and as such was not oriented towards producing truly global solutions to the energy problem. But, for producing local windmills addressing the needs of low cost and community managed energy production, the local activist networks have clearly been effective.

As for the revelation of new knowledge, the activist network shows a big contrast between revelation on issues and revelation on solutions. First, the revelation of new knowledge on solution has clearly been one of the main strengths of the networks. Through relying on the locally available and already well tested motor technologies in the farming industry, reliable and workable solutions to global issues have been elaborated effectively. However, because of the spontaneous character of the knowledge generation process, a big gap remains between the identified issues by

the activist network and the mainstream approach to the energy problem. In particular, in the absence of an organized mechanism, the scaling-up of the spontaneous grassroots innovations can be problematic or will not necessarily reflect the idiosyncratic framing of the problems as they were initially understood. An appropriate illustration of this is the contrast between the giant 2 MW offshore wind fields in north-western Europe which are an outgrowth of the windmill industry, but do not necessarily reflect the values of the community based grassroots innovation with the windmill cooperatives.

The speed of the innovation process has been rather moderate, precisely because of the difficulty to scale-up the innovations and the rather late support from higher level government initiatives. Some of this gap with higher level processes also generated problems of accessibility to the produced knowledge, which was not always in line with mainstream knowledge.

The main strength of this mechanism has been its cost-effective coordination. The coordination amongst a broad set of actors was probably made easier because it concerns a well identified technological entity with relatively low production costs. Also the networking among the local activists was facilitated by meetings and dissemination of performance through a local magazine.

Self-supplying, Carbon-free Communities (Neighbourhood Action) Over the past decade, numerous European communities have turned into carbon-free energy supply. They generate 100% of their electricity from renewable sources such as wind, biomass or solar energy. Due to the fluctuation of wind and solar energy, all communities either need biomass or hydropower as backup technologies to ensure continuous electricity generation. While these communities remain connected to the overall national or regional electricity grids, they produce as much electricity as they consume. However, most of them are largely self-supplying and build up decentralized supply systems that mainly aim at producing electricity for local demands. Several of the German 100% carbon free communities have been initiated by research projects such as the energy village of Jühnde in Lower Saxony. The communities are local in their scope while being focused on the global problem dimension. In addition, the initiatives are in most cases spontaneous since they do not follow a general pattern or are organized according to a general plan. However, they are largely designed inclusively. They require the participation of all community members and strong communication forces against other community members. Moreover, these communities often have decentralized decision making procedures. The mayor generally only serves as a moderator or facilitator, but not as initiator.

So far, little systematic research has studied the experiences of these communities and their inhabitants. However, with regard to the theoretical framework, these initiatives can illustrate the case of local neighbourhood. As such, the knowledge generated is uses by a number of projects. It mainly focuses on how to apply existing solutions in the local contexts. Thus, adequacy of the knowledge is given, but not overly strong. It is mainly transfer of knowledge on solutions as well as on issues from other contexts to the local specificities.

The knowledge being generated in the local carbon-free communities scarcely addresses the problems of climate change as such. Most activists in the community view them as given. It is therefore, a bit better in knowledge on solutions since the learning and knowledge generating process mainly builds on the transfer of existing knowledge to the specific conditions in the community. Within the community, in particular in the small villages such as Jühnde with its 750 inhabitants, the knowledge generation is generally rather quick. Knowledge spreads easily among citizens who often have similar problems in funding, technical implementation and alike. Accessibility of the knowledge is not very high, since the knowledge generated within the community are mostly very technical and specific. It is thus not well accessible for lay citizens that lack the necessary technical skills.

The most significant problem with the carbon-neutral communities is duplication of efforts. Due to the local character, it remains difficult to acquire and diffuse related

knowledge. Many communities have to reinvent the wheel to generate the central knowledge on how to install carbon-free areas. This can also be the problem for these projects since they might be well connected on the local level, while communication with other communities has hardly been established so far. The network of these initiatives is emerging and might contribute to the more effective transfer of knowledge and the coordination of effort.

4.4 Case Studies on Market Approaches and Global Activism

In this last section we turn to the cases that are all amongst the worst in generating knowledge on issues, while being in the same time bad or at least only moderately good in enhancing collective cognition on solutions. Amongst the market like coordination mechanisms, we first discuss the cases that are the worst on issues or on the worst on solutions. Then we turn to the cases of local self-regulation and global activism, which both have a moderately bad performance on issues and solutions.

Bioprospecting and its Improvements (Global Free-market, Legal Activism and Global Self-regulation) A clear example of Global free-market in environmental good is the case of access and benefit sharing through global bioprospecting agreements, as envisioned in the 1992 Convention on Biological Diversity. These agreements constitute an example of a so-called Coasian solution to the

compensation for environmental externalities. It is expected that by giving the property rights on the biological resources to the local communities and national organizations, monetary compensation for the use of these bioresources by private companies could be obtained through direct bilateral negotiation. This mechanism was expected to provide both financial income to the owners of valuable bioresources and be an incentive for increased stewardship for biodiversity. However, since the Convention many bioprospecting contracts have been signed (Rosenthal et al. 1999, OMPI 2001), but failed to deliver this promise.

From the point of view of the adequacy of the knowledge generated on biodiversity, this mechanism is rather poor. Indeed, it leads to extract the most accessible and already revealed knowledge, without a structured and systematic large scale scientific effort. Except in some cases of major government involvement in establishing the full inventory of biological resources in the biodiversity hotspots, such as in Costa Rica, the bioprospection contracts do not lead to large scale scientific analyses of the natural milieu and the knowledge available in the traditional communities. So the knowledge produced is very partial, focused on potential lead compounds that can come out of the "blind" screening of large quantities of biological materials, and does not integrate the full complexity of interdependencies between the different levels of organization of coupled human and ecological systems.

The revelation of knowledge is also very poor. There is no organized coordination amongst the main knowledge providers which could contribute to knowledge on the use value of the biological diversity in a more systematic effort, which are the natural scientists, the local communities, the public and private life science research communities and the private companies. As a result no effort is made by these actors to systematically investigate issues that could contribute to the overall knowledge base. For instance, in many cases, no research is done into the most sustainable way to exploit a certain bioresource, once it has been discovered. This has lead to the depletion even of valuable lead compounds identified in their natural environment.

Speed and accessibility of the knowledge generation process will suffer from this relative enclosure between the different knowledge generation communities and limited focus on the bio-chemical properties of resources with already well-known properties or revealed through blind screening of resources with unknown properties. In general, the production of knowledge on biodiversity will be slowed down, because less cumulative knowledge will be available and made accessible. The only advantage of the mechanism of bilateral contracting is speed. The spontaneous decentralized mechanism allows finding so-called "quick fix" solutions between companies and communities for working on some set of potentially interesting molecules, even if the quality of the knowledge generated in these agreements is very poor.

The poor coordination has in particular dramatic consequences for the duplication costs. No use is made of the rich knowledge base revealed by the global ecosystem's functioning and the communities' traditions. As a consequence, the potential gain in search costs by using already available know-how in the search for new pharmaceutical properties of biological materials are increased, which in turn decreases again the efficient use of the cognitive resources.

In the field of bioprospecting, local legal activism in the defense of GPG provision is often presented as a way to alleviate some of the negative aspects of the pure market solution. However, except for its local character, it shares a lot of the characteristics and weaknesses with the global free-market.

A well-studied example of the role of such legal activism in bioprospecting is the Kani Model of Benefit Sharing (KMBS). The KMBS is a widely acclaimed model of profit sharing. Indeed, it was the first example where payments have been made to holders of traditional knowledge for a successfully developed pharmaceutical product with therapeutic properties. This license agreement resulted from the incidental discovery of the therapeutic properties of a small herb by a group of scientists from the botanical garden visiting the Kani tribe in South-India. These individual scientists took the lead in negotiating a profit sharing deal between their employer, the local community and an Indian pharmaceutical company.

As in the case of the global market mechanism, the only real advantage of this mechanism for knowledge on GPG provision is that it makes some knowledge available on solutions very rapidly. Indeed, knowledge was only revealed by chance, by the encounter between a scientist and some members of the local community. Therefore, even if it is an improvement for the local actors, the activist intervention was not very useful from a broader perspective, which would require to explicitly designing methods to reveal the knowledge of the communities in a more systematic way.

Another type of improvement of the bioprospecting agreement can be found in global self-regulation. The idea here is to have coordination on the user's side of the biomaterials in order to prevent a race to the bottom between the companies and laboratories who are competing in their search for new biomolecules. Through a common agreement on access and benefit sharing, the idea is to enforce some common guidelines that can be used when accessing materials from providers' countries.

A recent example of such an improvement is the drafting of a standard agreement for transfers of biomaterials in the European Culture Collections' organization (ECCO). The main improvement of this mechanism is seen in the increased coordination in the drafting of bioprospecting agreements. Indeed the collections are intermediaries between provider countries of biological resources, mainly the biodiversity hotspots

situated in the South, and the users, mainly the industrial clients of the culture collections and the academic researchers. However, in spite of this major improvement, no change has been made to the quality and overall availability of the knowledge on biodiversity through the agreement. From the point of view of GPG provision the adequacy of the agreement remains weak. Indeed, it mainly addresses the curation and distribution of single biomaterials held outside nature in so called *ex-situ* collections. This type of holdings only contain only a small fraction of the full diversity that is out there in nature and which include many resources that cannot be preserved in fridges and other technical devices outside their natural environment.

The Chemical Industry's Responsible Care Initiative as a Case of Local Self-regulation The chemical industry launched its "Responsible Care" initiative in 1985 in reaction to serious disasters caused by chemical factories in Bhopal and other places. After its launch through the Canadian Chemical Producers Association, today almost all larger chemical manufacturers of the world declared their participation in the initiative. It is a voluntary undertaking that requires participating firms to comply with a set of fundamental environmental, health and safety norms under the coordination of national chemical industry associations. As an example of industry self-regulation (Gunningham 1995; King/Lenox 2000) no state authorities or other societal groups have been involved in the establishment and implementation control

of the rules. In this sense, the scope is narrowly focused on the chemical industry and its local plants. Individual companies play a central role in the implementation of the initiative's rules. They have do decide whether they participate in the initiative at all and how they do it.[6]

With regard to the adequacy, the knowledge being generated within and through the Responsible Care Initiative focuses mostly on solutions to the eminent problems of the chemical factories with environmental concerns, health and safety needs of the employees and the neighbourhood. The Initiative does little to analyse the problems e.g. of environmental or health risk through chemical substances at large or the environmental problems of plastics accumulating in the seas. It concentrates on solutions for the individual plants within a very broadly defined sustainable development framework. However the global and systemic problems of chemical products and the risks involved are not systematically addressed. Like other self regulation initiatives, the Responsible Care Initiative implicitly aimed at preventing more public and mandatory regulation. In this respect it was largely successful – also due to its well demonstrated expertise and global reach.

Among participating companies, it is mostly technical knowledge that is being revealed and transferred within strict limits. Where secrecy issues or competitive advantages are tackled, the knowledge sharing among firms remains largely limited. In stakeholder dialogues, companies also reveal some of this knowledge to externals.

However, there are severe limitations to which and how much knowledge is being revealed. The progress reports of the initiative itself are rather broad and hardly go into details. Revelation of the knowledge generated within the participating firms as well as in the coordinating national and international units is weak.

In its early phase, the initiative focused on spreading problem awareness among companies in the chemical industry. The organizers of the initiative were more successful with well-known larger companies than with smaller and less publicly recognized ones (King/Lenox 2000). In the later phases, solutions-oriented knowledge had to be diffused which was limited by the fact that competition even among participating companies hindered too open an exchange. Thus the knowledge diffused in a filtered and somewhat slow manner.

In addition, it is also most likely that the initiative leads to some duplication of knowledge across firms. Competition in the industry in some areas restricts the knowledge transferred to those solutions that improves environmental, health and safety standards with little relevance for the productivity of the firm. However, as long as public pressures remain rather low for implementing stricter regulations, the initiative will continue to fulfill many coordination tasks between firms and help to share data and information in a cost effective way.

Case Studies on Global Activism in Combating Climate Change The environmental non-governmental organization (NGO) Greenpeace is well known in the broader public through its media campaigns and spectacular protest activities. It addresses global environmental problems such as climate change, loss of species such as whales, marine pollution, and ozone depletion. On the basis of our theoretical framework, one would expect comparatively weak knowledge generating abilities of this mechanism. The case of Greenpeace and its climate change campaigns as example of a global activism confirms this assessment. Greenpeace and its campaigns are rather strong in diffusing emotional messages about environmental problems. As such, the organization is well equipped to raise public awareness for global environmental problems and to promote solutions. However, the organization is not a research body and does not produce original knowledge on the problem dimensions and only rarely on solutions. In contrast to the international level, the national and local campaigns are better in promoting solutions and in raising awareness for particular practical solutions to environmental problems since they often cannot afford to finance large media campaigns and cinema commercials, but can use their networks for supporting specific technological solutions such as CFC-free refrigerators. Through their interest in raising support, they are likely to be selective and to generate only those kinds of knowledge that raise attention with the

broader public and decision makers. Greenpeace will thus not reveal knowledge that broadly describes a problem, but is polarized or linked to resulting action.

Through its centralized decision making structure, Greenpeace in particular is able to act quickly and to rapidly diffuse new insights. It does not need to discuss and co-ordinate contents in great length with numerous individuals. However, most campaigns remain secret until they are launched to keep an element of surprise. Thus, accessibility in the early stages of a campaign is limited to a few internals. After publication, knowledge is widely accessible, in particular since it is often broadcasted in an easy-to-understand manner.

The selective and focused knowledge generation within organizations such as Greenpeace requires moderate efforts. On the one hand costs occur through the maintenance and operation of a global organization, while on the other hand the organization itself provides a coordination network that can be used for the diffusion of information and knowledge. At the global level, however coordination costs are low because the knowledge on issues is already in the public arena and no additional organization is needed to run and organize the knowledge generation process.

Global climate change campaigns by individual advocates (emotional collective action) show similar insufficiencies to the case of global activism. For instance, within the years between 2000 and 2008, the former US vice president Al Gore formed a US-focused, but globally active campaign to combat climate change. The campaign and

the outlined activities of Al Gore and his team have put a strong emphasis on providing knowledge on the problem dimensions, causes and impacts of climate change. In doing so, they do not generate new knowledge as such, but they prepare and diffuse existing knowledge—often in an emotional way. With its emphasis on diffusing existing knowledge, the campaign is weak in revealing original and new knowledge itself. It generally uses existing scientific knowledge and tries to deliver its messages as easy to understand as possible. Nevertheless, by using modern broadcasting media, it leads only to moderate coordination costs through the need to manage and coordinate global communication campaigns.

Conclusions

In this chapter, 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 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 chapter 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 13.4 approximately here]

[Table 13.5 approximately here]

[Table 13.6 approximately here]

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Notes

[1] 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.

[2] A detailed analysis of these trade-offs can be found in Brousseau and Raynaud (2009).

[3] 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.

[4] 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, conflicutality (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.

[5] Examples include Atmosfair e.V. , Berlin, Germany; Carbon Clear, London, United Kingdom; Climate Friendly, Sydney, Australia; TerraPass, San Francisco, California, US.

[6] Since all directly relevant decisions within the Responsible Care Initiative are taken on the local level, this governance mechanisms is seen as largely local. The global coordination leaves most initiatives to the local firms and their plant operators. This is why this Initiative features under "local self regulation" which is used as a simplified nickname as mentioned before.