Agence Française de Développement

Working Paper

September 2007 | 47

Governance of Renewable Natural Resources:
Concepts, Methods and Tools

Sheila Wertz-Kanounnikoff
Institut du développement durable et des relations internationales (Iddri)

Dominique Rojat
Agence Française de Développement (AFD), (rojatd@afd.fr)

Département de la Recherche

Agence Française de Développement
Direction de la Stratégie
Département de la Recherche

5 rue Roland Barthes
75012 Paris - France
www.afd.fr

Acknowledgements

We are grateful for the comments received by Alain Karsenty (CIRAD), Jean Boncoeur (University of Brest) and Olivier Godard (CNRS) on an earlier draft of this note. We further benefited from discussions with Martine Antona (CIRAD), Eric Brousseau (University of Paris X), Naïg Cozannet (AFD), Vincent Gitz (CIRED), Stéphane Guéneau (Iddri), Thomas Sterner (University of Gothenburg) and Jacques Weber (IFB). We finally acknowledge the financial support from the Agence Française de Développement (AFD) to conduct this work.

Disclaimer

Table of contents

Abstract

New approaches to deal with environmental and natural resource problems have evolved rapidly over the last fifteen years. In addition to new incentive measures, it is the rise of new actors and new forms of governance that have profoundly shaped the way resources are regulated today. In light of this development, this note compiles current concepts, methods and tools for the governance of renewable natural resources. It emphasizes the variety of options available – each of which can be the adequate regulatory response depending on the local political, socio-economic and ecological context. Because of the plurality of governance options, the heterogeneity of local contexts and the multiple interactions between sector policies and the overall macroeconomic framework, this note ends with a discussion on the desirability of a comprehensive policy evaluation framework to assist in the identification of the most adequate, context-specific form of renewable natural resource governance.

Résumé

L'approche des questions relatives à l'environnement et à la gestion des ressources naturelles a évolué rapidement au cours des quinze dernières années. Outre de nouvelles mesures d'incitation, c'est l'émergence de nouveaux acteurs et de nouvelles formes de gouvernance qui a profondément marqué la manière dont la régulation des ressources est conçue aujourd'hui. Au regard de cette évolution, ce document recense les concepts, méthodes et instruments actuels en matière de gouvernance des ressources naturelles renouvelables. Il met l'accent sur la diversité des options possibles, chacune pouvant constituer une forme de régulation adéquate selon le contexte politique, socio-économique et environnemental local. Du fait de la pluralité de ces options, de l'hétérogénéité des situations locales et des nombreuses interactions entre les politiques sectorielles et le cadre macro-économique, le document se termine par une réflexion sur l'utilité d'un cadre d'évaluation globale des politiques pour aider à identifier le meilleur mode possible de gouvernance des ressources naturelles renouvelables, en fonction du contexte.

Executive summary

Proper management of renewable natural resources (RNR) is critical to sustainable development. However, renewable natural resources (e.g. fisheries, forestry, soil or water) are special economic goods since they are not produced. Mismanagement and inefficient use can cause temporary or permanent environmental and economic damage, and thus threaten sustainable development, especially in developing countries where the welfare effects of renewable natural-resource degradation can be severe. Although mostly local in focus, these issues can create a global problem affecting the livelihoods of billions of people in communities around the world.

New approaches to deal with environmental and natural resource problems have evolved rapidly over the last fifteen years. Traditionally, natural resource management was characterized by sector-specific, command-and-control or fiscal approaches, such as the state management of resources or the taxation of water use. Such efforts, however, have proven insufficient. Shaped by the sustainable development agenda and the rise of the ecosystem approach in the 1990s, recent approaches tend to be more participatory, based more on incentives and negotiation. An important innovation is new forms of governance that, unlike the top-down control through hierarchy and individualized relationships coordinated through markets, involve new actors and are based on voluntary agreements and partnerships.

In light of these advances, this note compiles current concepts, methods and tools as regards the governance of renewable natural resources. We start with a brief presentation of renewable natural resource management principles and describe the evolution from a single-resource management approach to the more holistic, ecosystem approach. We also discuss the social, economic and ecological policy implications of each principle and argue that the ultimate resource management "optimum" is to a large extent a political decision.

The note continues by presenting alternative incentive measures for environmental regulation. These include not only legal (command and control) and market-based instruments, but also cooperation-inducing measures, such as voluntary contractual arrangements. We emphasize that the preconditions for all these instruments to function properly are adequately designed and consequently enforced property rights, liability rules, sanction mechanisms etc., and that any institutional change requires time. These requirements are not always met, especially in developing countries, and – in addition to information constraints and transaction costs – these are part of the challenges that policy makers face. Finally, we provide a reminder of the crucial role public authorities play in the implementation of regulatory measures, which contrasts with the idea of a spontaneous development of, for example, markets of tradable permits in the absence of public regulation.

Given the rise of new forms of governance over the past decade, we then characterize key actors and approaches applied to renewable natural resources. In addition to traditional public governance systems, such new forms include public-private governance models (public-private partnerships, co-management systems, global public policy networks) and purely private governance systems (community governance, corporate social responsibility, non-state market driven governance). The possible combinations of forms and level of coordination (i.e. actors and policy measures at different spatial scales) present a further challenge in the design of improved natural resource governance.

The note ends with a discussion of the practical implications for policy makers and donor agencies, specifically. Due to the plurality of governance options, the heterogeneity of local situations and the interaction effects between sector policies and the overall macroeconomic context, we propose a discussion on the desirability of a comprehensive policy evaluation framework to assist in the identification of the most adequate, context-specific form of renewable natural resource governance.

1. Introduction

Proper management of renewable natural resources (RNR) is critical to sustainable development. Especially in poor countries, natural resources constitute an extremely important share of national wealth. However, renewable natural resources (e.g. fisheries, forestry, soil or water) are special economic goods since they are not produced. Mismanagement and inefficient use can cause temporary or permanent environmental and economic damage, and thus threaten sustainable development. Although mostly local in focus, these issues can create a global problem affecting the livelihoods of billions of people in communities around the world.

The underlying causes of environmental and natural resource problems are manifold; many are still poorly understood and some have even not yet been identified. From an economic viewpoint, environmental and natural resource problems are primarily related to market failure arising from public goods characteristics (i.e. when there is no rivalry in consumption and no possibility of exclusion) or common pool resource characteristics (i.e. with at least partial rivalry in consumption) creating externalities (i.e. when individual costs and benefits of renewable natural resource use diverge from societal costs and benefits of renewable natural resource use). Information asymmetry (e.g. incomplete information) is another feature of environmental and natural resource problems that is conducive to opportunistic behavior and high transaction costs. Institutional and policy failure can present further causes of problems, as well as ignorance and uncertainty regarding ecosystem functioning and its inter-temporal, spatial and ecological complexities.

In particular, developing countries are often characterized by weak state institutions, poor market functioning and lack of resources, which challenge and undermine (any) policy implementation and enforcement. In such contexts, the welfare effects of renewable natural resource degradation can be severe. With natural resources playing a key role in generating wealth in poor countries, some therefore argue that natural resources (natural capital) should be explicitly considered in development strategies (Hamilton et al., 2006; Bojö and Reddy, 2003).

New approaches to deal with environmental and natural resource problems have evolved rapidly over the last fifteen years. Traditionally, renewable natural resource management was characterized by sector-specific, command-and-control or fiscal approaches, such as the state management of resources or the taxation of water use. Such efforts, however, have proven insufficient. Shaped by the sustainable development agenda since the 1990s, recent approaches tend to be more participatory, based more on incentives and negotiation, while also taking into account the lack of public funds available in developing countries for environmental and development policy making. An important innovation is new forms of governance that, unlike the top-down control through hierarchy and individualized relationships coordinated through markets, involve new actors and are based on voluntary agreements and partnerships.

In light of these advances, this note compiles current concepts, methods and tools as regards the governance of renewable natural resources with the objective of drawing lessons about the conditions required for their applicability.

This note is structured as follows: section two presents the main management principles; section three describes typical incentive measures for the management of renewable natural resources; section four discusses relevant models of governance; section five concludes and discusses the challenge for policy makers and donor agencies in promoting the most adequate form of governance for a given sector and context, without neglecting the interaction effects of sector policies at the macroeconomic level.

2. Management approaches

The approaches to renewable natural resource management have profoundly evolved over the last thirty years. While initial management principles were based primarily on a partial approach, focusing on one resource only (e.g. timber), more recent approaches tend to be more holistic by considering the entire ecosystem to which resources belong (ecosystem approach), including the market or non-market "services" (e.g. carbon sequestration) provided by ecosystems. However, the application of single-resource management principles to the economics of ecosystems and their services faces serious shortcomings. Scientific uncertainties hereby play a major role. Resource-oriented management principles remain of great relevance, as is the case in the fisheries sector, although the influence of ecosystem conditions on resource availability and renewal is now fully acknowledged. Each of these management principles has different ecological, economic and social implications. Each can thus present the justifiable management choice depending on the political priorities. In other words, the definition of the ultimate resource management "optimum" is largely a political decision. Given the variety of management principles, a fundamental question for donor agencies or public policy makers consists therefore in the "right" choice among these alternatives, considering the political priorities at stake. Based on the case of fish resources (although the points made are also valid for other natural resources), this section presents the alternative management principles and their respective political implications.

2.1 Sustained yield and associated principles

Shaped by the multiple-use philosophy on natural resource management, theoretical work on natural resource economics in the 1960s and 1970s focused on optimal harvesting rates to maximize the long-term yield potential of a given resource, with further extensions to include monopoly, uncertainty and other market imperfections. In this context, the two principles of maximum sustainable yield (MSY) and maximum economic yield (MEY) were common target setters for "optimal" resource harvesting, generally regulated through command-and-control measures. It is worthwhile to remember that these principles, in their original definition, only deal with ecosystem "goods" while neglecting ecosystem "services". A third option, although rarely accepted as principle for the management of renewable natural resources, refers to the situation of what has become widely known as the "tragedy of the commons" (free access). It merits attention for its social implication, as discussed below. After a description of the MSY and MEY principles, the following discussion therefore also presents the open access situation and its policy significance.

Maximum sustainable yields (MSY)

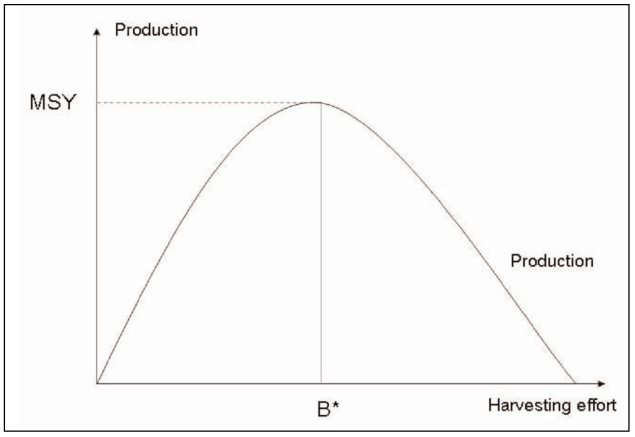
The maximum sustainable yields (MSY) principle from biological sciences was a highly influential criterion for the management of renewable natural resources during the 1960s and 1970s, and gained new momentum with the 2002 Earth Summit on Sustainable Development in Johannesburg. Based on a logistic growth model and especially applied to fisheries, the MSY represents the largest long-term yield that can be harvested from a renewable resource stock without compromising stock renewal (Markandya et al., 2001). The logistic growth model assumes that the annual net growth of a stock depends only on the biomass of the stock, which is itself dependent on the harvesting pressure. The net growth reaches a maxi-

mum when the actual, harvested biomass has been reduced to half the initial, non-exploited biomass. Harvesting at this point of maximal growth, while keeping biomass constant (i.e. not consuming the "natural capital"), corresponds to the MSY equilibrium or the biological optimum.

In Figure 1, the harvesting pressure corresponding to the biological optimum is referred to as B*. As the harvesting effort increases beyond B*, the biomass is further reduced and so is its growth potential and sustainable yield. After part of the biomass has been consumed, the system will reach a new equilibrium with higher effort but less production. The time needed to reach the new equilibrium depends on the life cycle of the species, or group of species, that constitute the stock. In the extreme situation, on the right of the curve in Figure 1, the biomass has been reduced to zero, which means that the stock is exhausted. On the other hand, at low effort levels to the left of B*, the biomass is higher but density dependent factors, such as competition for food and cannibalism of smaller individuals, start to reduce the net population growth. At some point based on the average carrying capacity of the ecosystem for the stock considered (where the harvesting effort is zero and the biomass in place is the maximum that the ecosystem can accommodate) net population growth becomes zero[1]. The seminal reference on the subject of optimal management of renewable resources is Clark (1976). From a policy perspective, the MSY matters when seeking to maximize the harvesting volume, e.g. to respond to nutrition needs or to gain foreign currencies through resource exports.

There are, however, reasons against the use of the MSY as a management concept. First, the MSY originates from biology and holds true for isolated species with standardized behavior. It cannot, therefore, be applied to species that are interdependent with other species, or species that are subject to natural fluctuations. Second, the MSY principle neglects any cost considerations, which means from an economic viewpoint that the MSY cannot present a reliable optimum. It has therefore been recommended that the MSY be regarded only as an orientation, or benchmark, rather than a norm.

Figure 1: Maximum sustainable yield (MSY)



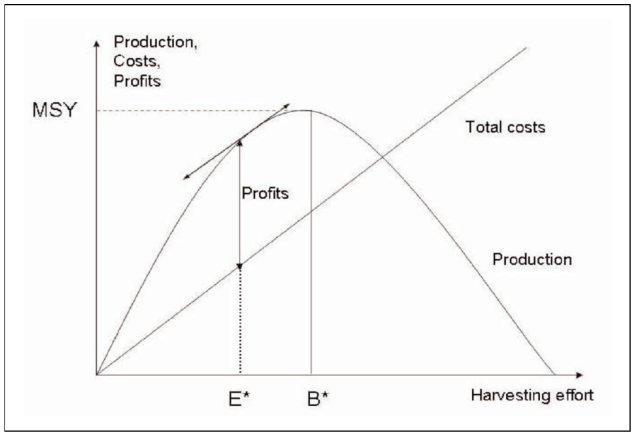
Source: The authors.

Maximum economic yields (MEY)

The maximum economic yield principle arose from the introduction of cost considerations into the previously presented biological growth model. This leads to a new harvesting optimum, which in Figure 2 is depicted by E* and corresponds to the harvesting effort in which the profits are maximized. From a policy perspective, the maximum economic yield (MEY) principle can be relevant when seeking to maximize the extraction of financial rent from the resource, e.g. for the state budget through fiscal revenues. The integration of economic aspects into the management of renewable natural resources gave rise to various bio-economic models, such as the Gordon-Schäfer Model in fisheries or Faustman's (1849) optimal rotation model in forestry. A main criticism of these approaches is that they are limited to a specific class of environmental problem, notably the increasing scarcity of the marketed or consumed components of a resource, such as timber or non-timber forest products (Barbier, 1989). Other, usually non-marketable functions or services of a given resource or ecosystem, as well as the condition of the underlying resource-supporting ecosystem, remain neglected. Yet, if nature as a whole is considered as providing a variety of essential ecosystem goods and services to humankind (MEA 2005), then the definition of economically valuable functions must be broadened to include not only the raw material (fish, timber) but all the other important environmental services as well. This

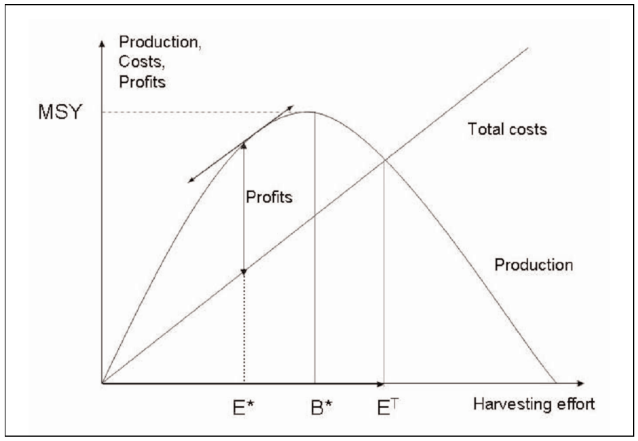
[1] Note that in reality, an unexploited stock will tend to fluctuate about this biomass because of environmental variability (Cochrane, 2002).

Figure 2: Maximum economic yield (MEY)



Source: The authors.

Figure 3: Maximum entrants (free access)



Source: The authors.

in turn would require a proper valuation of each of these functions and services and the way they interlink with economic activity, and the subsequent use of these valuations to indicate the trade-offs that may emerge from natural resource exploitation (Barbier, 1989).

Maximum entrants (free access)

In a situation of open access, nobody can be prevented from accessing and harvesting a given resource. Yet as new entrants start harvesting, the average returns from harvesting decline due to the overall limit of the stock. Open access situations are thus typically associated with negative production externalities; the yields of all resource users are affected by the entry of any new user. In this case, the social costs associated with resource extraction (i.e. yield losses for everybody) are not internalized into private decision-making. Assuming a price-taking and profit-maximizing behavior, the individual user only compares his private benefit to his private cost, and not to the social cost. Further costs imposed on the entire community are not taken into account. So in the presence of such production externalities, rational private decision-making leads to non-profitable harvesting regimes, which is typically a market failure. And even if the externalities are well perceived, the common-pool nature of the resource will lead each user to further increase harvesting efforts bsed on the motto "if I don't harvest myself, somebody else will". At the end, this culminates in the "tragedy of the commons[2]", i.e. in an inefficient equilibrium (E^T) where, although the number of resource users is maximized, resources are "over-exploited" with respect to the economic optimum E* (since profits of all users have been reduced to zero) and often also with respect to the biological optimum B* (Figure 3).[3]

Although barely acceptable from an economic and ecological viewpoint, there can be situations in which a policymaker will opt for harvesting efforts beyond the economic or biological optimum. For example, one motivation could be to maximize the number of people working in fisheries in order to increase employment opportunities (e.g. fisheries in the European Union, Senegal and many countries around the world). Pastoralism is another case when sound risk-management strategies and social criteria provide strong incentives to maximize herd size, even to the detriment of herd productivity, tending to make ET an optimal situation rather than a "tragedy", given the particular set of objectives and constraints in this sector. However, there are sectors, notably forestry, for which the characteristics of open-access or common-pool resources do not hold and for which the E^T situation cannot be taken as a reference.

In sum, this section presented alternative single-resource management principles to demonstrate that each principle can be the justifiable management choice, depending on the ultimate political preferences. While the MSY focuses solely on biological growth conditions, the MEY also considers economic conditions. The latter is often considered in the standard literature on fisheries as the "unique" optimum

[2] Or, more exactly: the tragedy *of free access*

[3] Note that the ultimate location of the "free access" equilibrium is defined by the slope of the cost curve. It can therefore be located beyond or before the MSY, yet in all cases it is beyond the economic optimum.

for fisheries management. However, the MEY can only be considered as the economic optimum if the optimality conditions hold (no price distortion, no information asymmetry, no transaction costs, etc.), and if there is no reason to promote other specific priorities, such as foreign-currency earnings, employment, food sovereignty and other economic, social and political objectives that are not captured in the MEY concept. Of course, the situation is different in the real world. For instance, the MSY can represent the optimal resource management principle for export-designated natural resources, if exports are at the center of the policy maker's objective function. In this case, foreign-currency earnings will be maximized at the cost of a lesser profit. Likewise, a harvesting effort towards the "economically inefficient" equilibrium E^T can be the political optimum if employment is the primary macro-economic objective or if cultural preferences predominate. For example, if maintaining pastoralists' activities has crucial societal relevance (e.g. in the Sahel zone), a policy maker may have a justifiable preference for ET as the resource management optimum, regardless of associated economic efficiency losses in terms of herd productivity.

2.2 Ecosystem and societal approach

A fundamental shift in renewable natural resource management occurred in the 1980s/1990s with the rise in prominence of the sustainability concept and the emergence of the ecosystem approach. The ecosystem approach was especially promoted by the Convention on Biological Diversity (CBD) adopted during the Rio Summit in 1992. It refers to an integrated perspective on the management of renewable natural resources by looking not only at one single resource, but also at the entire ecological system in which the resource is embedded (the landscape). This also includes an explicit recognition of the services provided by ecosystems. The underlying argument, therefore, is that the existence of a given resource largely depends on the health of its underlying ecological system. From an ecological viewpoint, "ecosystem resilience" is an important factor in preventing irreversible changes and guaranteeing healthy ecosystems. Resilience refers to the ability of an ecosystem to maintain its structure and behavior when faced with a change in the environment. Common (1995) suggests that resilience means that the system remains intact after an environmental change that does not necessarily require the survival of all species populations present before the change. According to the same author, a system is considered to be ecologically sustainable if it is resilient. Resilience depends on various factors, including species dynamics and diversity, and many of these are not even understood from a scientific viewpoint. This renders management a highly complex task and argues in favor of "adaptive management" and the application of the precautionary principle. Specifically, adaptive management refers to sustainable management practices (for both ecosystems and species) that are responsive to uncertainties and ecological fluctuations, as well as being reversible and flexible (Barbier *et al.* 1994). Although desirable from an ethical viewpoint due to its long-term sustainability objectives, the actual implementation of the ecosystem approach is highly complicated. Difficulties pertain especially to the ongoing uncertainties and ignorance regarding ecosystem functioning and consideration of these factors during the management process.
Hence, with the emergence of the ecosystem approach, natural resource management shifted from partial, single-species/resource analysis (MSY, MEY) to a more holistic (ecosystem-based) perspective. This latter idea consisted not only in an explicit consideration of ecological complexities (dynamics of multiple species), but also of other social and economic aspects associated with the use of a given resource. Such holistic approaches require new forms of management, allowing for greater involvement by the stakeholders associated with a resource or ecosystem. The objective of greater stakeholder involvement raises questions about the appropriate form of stakeholder coordination (governance). Before dealing with possible forms of governance, the following section takes a step back and focuses on the available toolbox of incentive measures that can be used to regulate the use of renewable natural resources.

3. Incentive measures

There is a wide array of regulatory measures for coordinating the use of renewable natural resources. These can be distinguished as legal restrictions, market-oriented measures, and cooperation inducing measures. While the first two belong to the traditional set of environmental policy instruments, cooperation inducing measures, such as voluntary agreements or contracts, have only recently gained prominence in practical renewable natural resource management.

The adequacy (effectiveness) of incentive measures depends largely on the economic characteristics of the ecosystem goods and services considered. Based on the characteristics of excludability (i.e. feasibility of controlling access to a good or service) and rivalry in consumption, four classes of ecosystem goods and services are typically distinguished:

- **Private goods**: These are goods and services for which consumption is rival and exclusion is feasible, such as the case with private forest lands.
- **Club goods**: These are goods and services for which consumption is non-rival and exclusion is feasible, e.g. scenic views in a protected area where visitors must pay an entrance fee.
- **Common-pool goods**: These are goods and services for which there is rivalry in consumption, but exclusion is impossible, difficult, or subject to certain conditions. This is the case with fish resources, fuel wood or pasture land.
- **Public goods**: These are goods and services for which there is neither rivalry in consumption nor feasibility of exclusion, such as the case with clean air.

Note that the feasibility of exclusion depends not only on the physical attributes of a good or service, but also on the contextual factors such as location. A private lake that is located far away from one's house might be more difficult to control than one closer by. This is due to the associated transaction costs, which in some cases make "exclusion" prohibitively expensive and thus economically inefficient. In other words, excludability is not an absolute criterion but depends also on the costs involved in enforcing exclusion, including transaction costs arising from social characteristics and structures.

In addition, the effectiveness of incentive measures depends further on the institutional framework in place. Adequately designed and consequently enforced institutions are a fundamental pre-condition for policy instruments to function properly. This requirement, however, is not always met, especially in developing country contexts, seriously undermining any regulatory approach. Generally speaking, institutions can be defined as "the rule of the game in a society" or "the humanly devised constraints that shape human interaction" (North, 1990). Institutions are the implicit foundation for all economic transactions, and their crucial role in renewable natural resource management has been emphasized by various scholars (e.g. Ostrom, 1990; North, 1990; Bromley, 1991). But institutions were long taken for granted and largely neglected in the economic analysis. As the distinguished economist Williamson (2000) noted, "We are still very ignorant about institutions". Yet institutions play a very significant role since they are not only the foundation for all instruments and governance structures, but they can sometimes become instruments themselves, such as when regulators consciously choose to enhance institutional structures. In the early property rights literature, for example, the solution to the "tragedy of the commons" was seen in the creation of clearly defined private property rights (e.g. Demsetz, 1964; Hardin 1968). However, the definition of property rights or institutional change requires time, a requirement not always in accordance with the operational realities of policy makers and donor agencies.

Moreover, information plays a special role in policy making and can sometimes also be considered as an instrument in its own right (Sterner, 2003). Information asymmetries strongly influence the incentive structure in place to use or govern a given resource or ecosystem, and one way to reduce information asymmetries is through cooperation-inducing measures, as will be discussed below. Yet information-based measures can also make externalities visible and thus help people understand the actual benefits and costs of particular management techniques. Examples include: capacity building and technology transfer; surveys revealing public preferences on the costs and benefits of ecosystem goods and services; monitoring systems that can facilitate the enforcement of rules (Fischer *et al*., 2004). Hence, proper access and use of information can be a precondition for effective public regulation while also being an incentive measure in itself.

Lastly, real world regulators are hardly in a position to actually choose among several policy measures or to introduce them in isolation. Often, real world policy making is the result of the power configuration existing between stakeholders and interest groups, rather than a decision made by the regulatory authority only. Moreover, due to political-economic factors, the ultimate policy measure is only the second-best solution and often a combination of several regulatory measures. Such political-economic factors, previous policy choices, cultural values, as well as existing socio-economic and institutional structures, strongly influence the implementation and effectiveness of a given policy measure. For contexts in which administrative regulations have predominated, for example, the introduction of market-based instruments will face profound challenges (Godard, 1991).

These points underline the crucial relevance of careful ex-ante assessment of the initial conditions to identify the most adequate incentive measure (or mix of measures). The following section presents typical incentive measures for resource or ecosystem regulation. Note that these measures basically deal with the question of "how" to manage resources or ecosystems; the question of "who" (which stakeholder) will manage a given resource or ecosystem, and under which governance system, is the subject of the section thereafter.

3.1 Legal regulation

The traditional instruments for regulating access to, and use of, renewable natural resources were of a regulatory nature. Generally speaking, legal or administrative instruments are measures that explicitly require or restrict specific actions on the part of individuals or firms. They are a fairly common type of policy instrument in natural resource management. Examples include: quota systems regulation for the exploitation of biological resources, such as fish or wildlife; the establishment of national parks; access regulations for hunting or fishing areas (licenses); fire bans during the dry period; mandatory replanting of trees after harvest; or mandatory use of a certain technology to fish, hunt or farm. The advantages of these approaches are their intuitive simplicity and that pre-formulated objectives can be achieved with high probability, as long as adequate monitoring and enforcement can be assured (OECD, 1999).

The relative efficiency of quantity instruments (to which legal measures belong) compared to price instruments (taxes) has been the subject of considerable academic debate, starting with the work by Weitzman (1974). In essence, Weitzman demonstrates that given perfect information, price-based mechanisms and quantity-based mechanisms can be equivalent; in cases with incomplete information, the specific circumstances define which mechanism is more efficient.

Legal measures are criticized for being inefficient, as it is typically not feasible for the regulator to have knowledge about the individual resource-use practices due to prohibitive information requirements and administrative costs (high transaction costs typically translated into high financial costs). Another criticism refers to the neglect of economic aspects in the design of legal measures, which hardly provide sufficient incentives for reducing externalities. For example, while global quotas may potentially reduce overall resource depletion, they can also induce adverse effects and thus be economically inefficient (e.g. fisheries and the "race for fish") in contrast to individual quotas (see below). Moreover, legal instruments are fraud-prone, and

many — such as the limitation of private property rights — can be misused to protect the interests of powerful resource stakeholders rather than the resource itself (Sterner, 2003). The reasons why legal measures are still the most commonly used instruments include (from a traditional economic viewpoint): their intuitive simplicity; the short time horizon of many policy decisions (i.e. policy responses are often expected to be visible within a short time period so that policy makers or funding agencies can take credit for these responses); and their higher public acceptance due to the perceived associated lower costs compared to other instruments (*ibid*). Still, the value of legal regulations is recognized in defining the overall framework for economic activity, including the correction of market failures, such as in the case of ecosystem goods and services with public good character.

3.2 Market-oriented measures

Market-based incentives are measures that have an impact on people's activities within markets, usually via the price mechanism. Instead of imposing restrictions on the individual decision-making process, market-based incentives seek to affect the decisions by introducing new elements into the equation. Individuals are left free to make their own decisions while taking into consideration signals set by the government or other non-state actors regarding the value of different environmental resources. The virtue of these approaches lies in the theoretical expectations that they will: (i) minimize the costs of complying with regulations; and (ii) stimulate technological change because the tax (or need to buy permits) is avoided if the environmental damage is reduced (Pearce, 2002). Note that over-exploitation of a resource generates production externalities that within the scope of this note are also referred to by the term "pollution". Typical market-based instruments include taxes and tradable rights. Yet the removal of adverse incentives (e.g. agricultural or fisheries subsidies), although usually not considered as a policy instrument on its own, can be viewed fundamentally equivalent to the imposition of taxes (Goeschl and Lin, 2004).

Important to note is the crucial role of public authorities in the implementation of market-based instruments, which contrasts with the idea of a spontaneous development of, for example, markets for tradable permits in the absence of public regulation (Godard, 2000). In the case of taxes, for example, it is the regulator who modifies the price signal to then let the market determine its new equilibrium (e.g. the level of the water tax defines the water quantity consumed). In the case of tradable permits, on the other hand, the regulator defines the quantity of the regulated good or service and lets the market determine the corresponding price. Hence, although the market determines access and use of a given resource, it is the regulator who shapes the initial conditions.

Environmental taxes and charges

Taxes are among the most traditional market-based instruments. They can have manifold objectives, including: royalties (e.g. tax levies on extracted resources); income taxation; charges for public services (e.g. waste disposal); correction of environmental externalities, i.e. eco-taxes sensu stricto (see next paragraph on environmental taxation); and targeted support to a sector or activity (e.g. tax relief for the implementation of agricultural projects in the Brazilian Amazon during the 1970s). At least since the 1970s, the application of environmental taxes has been widely promoted by major international organizations, such as the Organisation for Economic Co-operation and Development (OECD) and the World Bank. Water and forestry are of special interest in this regard. The application of fiscal instruments in forestry was addressed by Engelin and Klan (1990) and Karsenty (2002).

The notion of an environmental tax related to the money value of environmental damage dates from Pigou (1920). He argued that in the case of externalities (when the marginal private net product deviates from marginal net social product), intervention through a tax would be justifiable as a means of maximizing economic welfare (Pearce, 2002). The basic idea is that for any given tax rate, each polluter will reduce environmental damage up to the point where his marginal abatement costs are just equal to the tax. In this way, the marginal abatement costs of all polluters are equal, a result that also meets the requirement of minimi-

zing the sum of all abatement costs. The notion of the polluter paying for the environmental damage he causes became the "polluter pays" principle coined by the OECD (1975). Environmental taxes can take many forms, such as conservation levies to discourage environmentally damaging activities or non-compliance fees.

There is considerable literature on how a system of Pigouvian taxes can generate efficient outcomes by internalizing the negative externalities and therefore inducing individual agents to produce the public goods (in this case: environmental conservation) at the socially desirable levels (Baumol, 1972; Baumol and Oates, 1988; Oates, 1995; Lévêque, 2000). A fundamental condition hereby is that the marginal benefit and cost curves are observable with sufficient accuracy and at a sufficiently low cost. Studies showing how uncertainties regarding marginal benefit and cost curves can result in inefficiencies started with the work by Weitzman (1974).

The optimal aspects of pure environmental taxes, however, are based on several classical assumptions (full information, honesty, benevolent regulator, appropriate concepts of property rights) that are not always fulfilled in reality, thus complicating the use of taxes in many cases. When individual damage to renewable natural resources cannot be observed with sufficient accuracy at a reasonable cost due to unknown biological processes (biological uncertainty), stochastic influences (natural variability) or the inability to measure individual contribution to an environmental problem (monitoring problem), Pigouvian taxes will not be appropriate (Goeschl and Lin 2004).

For example, eco-taxation may be useful in the case of fisheries or pastoralism, for which the environmental impact (externality) can be approximated by the amount of fish extracted or the number of livestock units. But this is different in the case of forestry, since a tax on extracted timber volume would not correspond to the environmental externality associated with timber extraction. Indeed, research has demonstrated that a tax on the volume of extracted timber does not correspond to an environmental tax in the Pigouvian sense since the social and environmental damage caused by timber extraction is far from being solely dependent on the volume of extracted timber (Paris and Ruzicka, 1991; Leruth, Paris and Ruzicka, 2001). An alternative to taxes on individual activities consists in ambient taxes, i.e. a charge per unit deviation between a desired and a measured ambient concentration level, imposed on every potential polluter when measured ambient pollutant levels exceed some desired cutoff level (Xepapadeas, 1995), as suggested by Segerson (1988) and Xepapadeas (1991, 1992) in the context of pollution control. In the context of renewable natural resources, ambient taxes may be useful for soil and water pollution from pesticides.

In addition to methodological constraints, political-economic factors present further limitations in the design of "true" Pigouvian taxes. The basic requirement for the Pigouvian tax to work consists in the possibility that a levy on the socially damaging activity will narrow the distortion between the private and social costs of the activity. However, in many cases this condition is not fulfilled, and taxes are too low compared with the externalities they should price, or they are imposed on the smaller rather than the larger polluters, granting the latter substantial exemptions (Andersen, 2006). Very often, indeed, taxes are used to augment fiscal revenues rather than to correct market failures.

There are thus a number of theoretical, methodological and political-economic constraints on the implementation of pure environmental taxes. Since taxes essentially cause price distortions[4], precaution is required, especially with respect to the (incentive and distributional) effects of a tax, which need to be evaluated *prior* to implementation. An export tax on primary products, for example, can lead to an excess of the product on the local market and thus to an artificial price decrease and wasteful resource use (for forestry and the so-called *cheap log policy*, see Karsenty, 2002). On the other hand, tax cuts for local resource transformation activities can lead to less efficient processing and over-capacity, thus decreasing the value-added (for fisheries, see Rojat, 2006). Likewise, it is crucial to assess *who* is ultimately paying for a given tax since taxes can be transferred to third parties, not to those originally targeted. In sum, taxes have a strong theoretical basis and can be very efficient economic instruments, but they can hardly be the panacea for internalizing environmental externalities; their adequacy (whether or not in combination with other instruments) needs to be assessed in each individual case. In

[4] With the exception of Pigovian taxes, which specifically aim at correcting market failure.

particular, the requirements of functioning markets, clearly defined property rights and governance structures, as well as information and monitoring issues, seem to present the main challenges for the application of environmental taxes in developing country contexts.

Tradable permits and rights

Another important market-oriented incentive measure is tradable permits and rights. The theoretical foundation is Coasian (Coase, 1960), although the instrument is generally ascribed to Dales (1968). Coase (1960) argued that, first, the direction of a pollution externality depends on property rights; secondly, when transaction costs are low, for example in cases with a small number of victims and an equally small number of polluters, voluntary bargaining between the two parties – rather than a Pigouvian tax – will lead to the optimal solution, since bargaining will be relatively cost-free. However, Coasian bargaining only works under the above conditions. As the number of polluters and victims increases, for example, bargaining is no longer cost-free, and both individual and group interests tend to diverge. Following up on Coase's approach, Dales (1968) argued that in many cases it is not possible, or desirable, to distinguish between polluters and pollutees.

Dales' suggestion was therefore to create an authority that would decide total pollution and sell "rights to pollute", whereby the sum of the pollution allowed by the permits corresponds to the total level of decided pollution, and the market allocates the total quota among firms, as reflected in their demand for permits or their abatement costs (Dales, 1968). Because pollution without a permit is not allowed, each stakeholder is expected to reduce environmental damage as long as the cost of doing so is less than the price that would have to be paid for a permit. In consequence, a high abatement-cost polluter will tend to buy permits, whereas low-cost polluters will sell permits. The equilibrium price for the permits is determined by the permit market. Although much younger in practice, tradable permits have developed rapidly and successfully in public policy (Pearce, 2002). Systems of marketable permits have been widely and successfully used in fisheries in the form of individual transferable quota (ITQ) programs (Sterner, 2003), or in land management in the form of tradable development rights (TDR), such as currently explored in Brazil (Chomitz et al., 2004; Chomitz, 2004). Further prominent examples of marketable permits include the United States SO2 cap-and-trade program since the early 1990s and the European CO2 emission trading system since the early 2000s.

From a policy making perspective, tradable rights have the advantage that once the system is put in place and permits distributed (via auction, grand-fathering or other mechanisms), the market will coordinate the allocation of permits among the resource users. Grand-fathering is often the politically more feasible allocation option, although from an efficiency perspective, it is generally viewed as a second-best solution compared to auctioning, for example. Auctioning tradable permits for resource use has specific advantages and disadvantages. On the one hand, auctioning of permits (or licenses) reveals information on the profits obtained from extracting or using a given resource, thus ensuring the identification of the "right" price through the "invisible hand" (the market). On the other hand, differences in technological performances, price uncertainties, administration and transaction costs as well as resource heterogeneities (e.g. forests are not homogeneous) may hinder auctioning efficiency. Speculation or money laundering can also create adverse conditions (although not limited to the context of auctioning). Possibilities for overcoming these difficulties include periods of validity sufficiently long enough to ensure investment security and to discourage speculation, as well as deposit or final-sanction measures to induce good management practices.

Tradable permit systems can be quite cost-efficient. However, whether tradable permits are the adequate policy measure needs to be decided on the basis of efficiency, equity and legitimacy. The latter is not always ensured since the underlying assumptions of tradable permits are based on the concept of exclusive property and on the prerequisite that the involved actors adhere to market logic in their practices; such requirements are not always fulfilled in the context of developing countries (Karsenty, 2004). Moreover, for these instruments to work, there are certain conceptual and practical issues to overcome, basically dealing with: the proper definition of property rights (what do the rights consist of and who may claim such rights); the validity of these rights (for a limited time period or in perpetuity); and the requirement that the rights are enforced once assigned, including efficient monitoring and sanction mechanisms (Sterner 2003). The

considerable time and effort required to design and install a system of tradable permits might not correspond to the policy maker's objective of producing visible results within a given election period.

3.3 Cooperation

Cooperation-based incentive measures are some of the more recent instruments used in renewable natural resource management, especially concerning the management of common pool resources (CPR). As explained before, CPR can be characterized by rivalry in consumption and by non-excludability, which ultimately allows for free-riding (i.e. private actions whose costs are borne by the entire society, as in the case of over-fishing or over-grazing). The game "prisoner's dilemma" is commonly used to illustrate the problem of free-riding vs. cooperation and offers insight into the overuse of resources when incentives to cooperate or ownership control is insufficient. The game is as follows: Two prisoners are questioned separately about a crime they are supposed to have committed. Each may give evidence against the other or may say nothing. If both say nothing, they get a minor reprimand and go free because of the lack of evidence. If one gives evidence and the other says nothing, the first goes free and the second is severely punished. If both give evidence, both are less severely punished. The overall (globally) best strategy is for both to say nothing. However, not knowing (or trusting) what the other will do, each prisoner's (individual) best strategy is to give evidence, which is the worst possible outcome.

Hence, the solution to the "prisoner's dilemma" is cooperation. The concept of cooperation refers to the practice of people, or greater entities, working together with commonly agreed-upon goals and possibly methods, instead of working separately in competition. Within a game-theory analysis framework, Axelrod (1984) revealed the benefits of reciprocal cooperation and how trust and a reputation for cooperation make "rational" cooperation a more likely outcome (Gillinson, 2004). With respect to CPR management, cooperation inducing measures can help overcome the "prisoner's dilemma" and induce more sustainable resource use. Measures to induce cooperation include contracts or organizations. Note that strong institutions are a precondition for the proper functioning of contracts or organizations, which again need to be ensured by public regulators.

Contracts

Contracts can be used to induce cooperation. Contractual arrangements can be defined as written or traditional mutual agreements, enforceable by law or customs, between two or more parties that something shall be done by one or both. In the realm of renewable natural resources, there are two major types of contract governing the rights of owners and users over resources: (i) resource utilization contracts, including leases, concessions, licenses and permits; and (ii) service procurement contracts for environmental management, such as protected-area management, forest monitoring or payments for environmental services (Morell, 2001).

A key concern in the development of contracts has been to ensure that the contracts are drawn up as efficiently as possible. A major source of efficiency losses (and the motivation for contracts to exist) is due to the presence of information asymmetries between the contracting parties. The principal-agent model is designed for situations in which non-peer players with only partially common interests act in an asymmetrical information context. The model stages a regulating authority (the principal) and one or more operators (the agent(s)), who conclude a contract under which the agent agrees to comply with the objectives set by the principal in exchange for positive sanctions. In this context, contracts may provide efficient organizational alternatives to a dysfunctional market. They are designed to minimize transaction costs and create incentives and control mechanisms aimed at conflict resolution and cooperation.

Three types of contract-theory problems are commonly encountered within the principal-agent set-up: The first, *moral hazard*, refers to a situation in which there is symmetric information between the involved parties at the contracting stage but asymmetry of information arises during the relationship through: (i) hidden actions, i.e. the agent takes an action that cannot be observed by the principal, and the principal observes only a noisy signal of the action; or (ii) hidden information, i.e. the principal

observes the agent's actions but does not know whether the action is appropriate. The second is *adverse selection* and refers to situations in which asymmetric information is present before the parties negotiate the contract, thus allowing the better-informed party to influence the terms of the contract for its own benefit. The third deals with *non-verifiability* and refers to a situation in which the involved parties are symmetrically informed, but cannot verify this to the courts and have thus to rely on mutual confidence.[5] See Martimort (2005) or Brousseau and Glachant (2002) for a brief overview on contract theory; for more in-depth literature, see Bolton and Dewatripont (2005), Laffont and Martimort (2002), or Salanié (1997). For a more operational approach to contract design for renewable natural resources, see Morell (2001).

Payments for environmental services (PES) present a currently very popular contract mechanism for inducing the conservation of renewable natural resources. Based on voluntary contractual agreements between providers and beneficiaries of environmental services, examples include the national-level payments for the environmental services' program in Costa Rica (Rodriguez, 2006), or the Regional Integrated Silviopastural Ecosystem Management Project, financed by the World Bank and implemented in Colombia, Costa Rica and Nicaragua (Pagiola *et al.*, 2004). For a general introduction to payments for environmental services, see for example Wunder (2005); for a presentation of PES for forest conservation, see Pagiola *et al.* (2002).

Voluntary agreements can be seen as further variants of contracts. Voluntary agreements have two objectives: notably, to provide more flexibility to the private sector; and, on the global level, to counter problems of articulation between international trade and natural resource management. Four types of voluntary agreements are typically distinguished: (i) voluntary, unilateral commitments by firms; (ii) environmental agreements resulting from direct bargaining between polluters and pollutees; (iii) environmental agreements negotiated between industry and public authorities; and (iv) public voluntary programs, such as audits, certification or labeling. An example of a voluntary agreement is the two-year moratorium on soybeans from deforested areas in the Brazilian Amazon, which was declared by major soybean traders in July 2006. For a detailed presentation of voluntary agreements, see for example Börkey *et al*. (2000).

Organizations

Organizations present another mechanism for inducing cooperation. They can be defined as an institution that consists of a group of individuals bound by some common purpose to achieve objectives (North, 1990). They can also be viewed as a network of relational contracts between individuals with the objective of regulating economic transactions (Richter and Furubotn, 2003). They can be formal or informal in nature. Examples include political bodies (political parties, regulatory agencies), economic bodies (firms, trade unions, cooperatives), social bodies (churches, clubs, associations) and educational bodies (schools, universities). In the area of the environment, examples are watershed agencies or common property resource (CPR) management systems.

From an institutional economics viewpoint, organizations evolve in response to positive transaction costs, which arise basically from information asymmetries. The existence of pricy transaction costs is the fundamental postulation of the new institutional economics. Transaction costs represent in the real world the costs of gaining information, negotiating contracts and monitoring contract implementation. Transaction costs may then be defined as the resources spent for the creation, maintenance and use of institutions (Richter and Furubotn, 2003). Transaction costs were first discussed by Coase (1937), who argued that the decision on whether to do a transaction within a firm or in the marketplace is determined by transaction costs. He suggested that the chosen form of control (the firm or the market) would tend to be the one with the lowest transaction costs. In other words, if given a choice, individuals will most likely choose the set of institutions, contracts or transactions that minimize the (transaction) costs of doing their business.

As equivalents to Coase's firms (Coase, 1937), organizations can present an appropriate choice in the regulation of renewable natural resources, as in the form of watershed-management agencies, local users groups or cooperatives. Theoretical contributions on the design and functioning of organizations are provided by several economic sub-disciplines. There is substantial literature on industrial (firm) organizations (e.g. Williamson 1981*a*, 1981*b*) and organizational governance (Williamson, 2005).

5 Some authors use a different classification. Laffont and Martimort (2002), for example, identify moral hazard with "hidden action", and adverse selection with "hidden information". It is thus crucial to verify which information structure is implied.

4. Governance models

Over the last decade, new forms of governance have widely emerged in the environmental arena. The traditional definition of "governance" is "the act or process of governing" and largely synonymous with "government". Recent usage of "governance", however, typically distinguishes governance from government, to refer to new forms of coordination through networks and partnerships that differ from the top-down control through hierarchy and individualized relationships coordinated through markets. The rise of new forms of environmental governance refers hereby not only to the emergence of new actors (private sector, NGOs) and policy instruments (contracts, partnerships), but also to new forms resulting from various combinations of the two and their implementation at different spatial scales, leading to new forms of coordination (local versus regional public-private partnerships, regional co-management schemes). The question of the "right" spatial scale refers to the range of possible levels of governance, from local stewardship (through decentralization or community empowerment) to international coordination through multilateralism or international private networks.

Governance also gained further relevance given, at the same time, the enhanced questioning of the logic of state production of public goods (the state financing the provision of public goods, such as waste collection or the management of public forests). This resulted in a retreat of the state from production activities, which lead not only to the emergence of new governance systems (e.g. public-private partnerships) but also to new policy tools (e.g. contracts and partnerships).[6]

These new forms of coordination or governance raise the question of when to promote which model of governance and at which spatial scale (local, regional, national). This decision is clearly linked to a proper evaluation of the associated costs and benefits (i.e. performance, operability, etc.) of alternative governance structures. The following section provides a brief overview of the variety of stakeholders involved in forming new forms of governance. We then discuss alternative combinations of stakeholders ("who") and instruments ("how") that ultimately form such systems of governance.

4.1 Actors of governance

On the actor side (the "who"), we basically distinguish two main actors of governance: the state; and the civil society. Since the civil society is a heterogeneous group, we prefer to decompose the civil society into private firms, non-governmental organizations (NGOs, trade unions) and the community. Recall that our intention consists more in illustrating the plurality of (local) actors and their stake in renewable natural resource use rather than in providing an exhaustive list of actors.

- **State**: The state is probably the most traditional actor of governance and was long perceived as the only governing authority. As the guarantor of collective interests, the state is expected to act in the society's best interest and thus to ensure the realization of macroeconomic objectives (e.g. employment, social equity, international

6 Note that academic questioning of the State providing public goods had already started much earlier among scholars of the Public Choice theory.

trade, environmental quality), the provision of public goods and services that otherwise would not be delivered by the market, and the provision of other legal or institutional infrastructures that reduce transaction costs and support individual economic activities. Without advocating for an altruistic, "benevolent dictator", we still expect the state to pursue societal preferences that are not necessarily the aggregation of individual preferences (as assumed by the neoclassical economic theory). Such collective environmental preferences can include the conservation of biodiversity or national parks that maintain ecosystem services. In other words, the state's interest in resource or ecosystem management is expected to ensure the overall societal interest. However, the state is hardly in a position to ensure on its own the realization of collective preferences. The characteristics of environmental and natural resource management problems, together with the constraints on the public budget and limits on the efficiency of state action, induce the state to consider new forms of governance and to collaborate with other stakeholders to ultimately respond to societal preferences and ensure effective environmental regulation.

- **Local governments**: Local governments are part of the public authority system although under the state authority. Since local governments are situated closer to their voters, they are expected to show greater propensity for strategic decisions, such as the creation of visible and immediately profitable infrastructure projects, rather than providing an invisible environmental public good with long-term benefits. On the other hand, local governments are closer to local realities and thus affected by local environmental problems, such as can arise from inadequate resource management practices. In sum, local governments are expected to have more opportunities to identify locally feasible and efficient regulatory responses to natural resource management concerns.
- **Private firms**: Private firms have become a crucial actor in environmental governance. The emergence of multinational firms investing and acting in different countries, mostly supported by local public authorities to achieve greater economic development, has given them substantial bargaining power on what concerns environmental policy making. But also small- and medium-sized firms have emerged as pro-active, policy shaping entities. The underlying motives of the private sector are based primarily on profit-maximization. Private firms' stake in renewable natural resource management is in the form of resource harvesters or users. As stakeholders in environmental governance, private firms have become involved in seeking certification for environmentally and socially sustainable production processes or products, or actively elaborating standards of corporate social and environmental responsibility, such as the World Business Council for Sustainable Development. They have also developed partnerships with other actors.
- **Non-governmental organizations (including trade unions, etc.)**: NGOs have emerged as another crucial actor in the environmental governance arena. The ultimate motivation (stake) of NGOs is based on each organization's specific agenda (environmental, social or other objectives). As regards the coordination of renewable natural resources and ecosystems, NGOs have become important stakeholders in environmental regulation. They have not only proposed new policy instruments (e.g. "conservation concessions", an instrument developed by Conservation International that basically consists of agreements between the NGO and the state or local land users to conserve a given area for a predefined time period in exchange for compensation), but also new forms of stakeholder coordination, such as partnership trust funds or independent certification schemes.
- **Community**: The community refers to the unorganized part of the civil society. Strictly speaking, however, this class overlaps with all the other actor categories since each individual is also part of the community. Still, we hereby refer to the share of the population that has not been covered by the other classes. Communities also embrace harvesters or users of renewable natural resources. Yet due to the lack of organization, their voice in environmental regulation is a priori probably the weakest. Finally, the community consists of consumers who through their consumption choices can influence environmental practices, e.g. by opting for eco-certified products or by soliciting services of a firm with socio-environmentally friendly practices.

In addition to the question of who should be involved in the coordination of resources or ecosystems, there is also the question of which model of governance to choose, i.e. which combination of actors and instruments should be envisaged. This again is a crucial question for policy makers and donor agencies. To shed light on the variety of actors in the governance of renewable natural resources, we provide in the following paragraphs a brief presentation of governance models that we find relevant for the coordination of renewable natural resources. Without neglecting the role of legal or market-oriented measures, we emphasize that a crucial requirement for these governance models to function are institutions and contractual arrangements.

4.2 Public governance models

Public governance models attribute a key role to public authorities, i.e. central governments (the state) or local governments. Legal measures are among the traditional regulatory measures through which the state defines how much, where, or by whom a given resource may be used. Examples include land zonings or the designation of national parks. Yet the application of market-based instruments also requires some type of public intervention. Even if the access and use of renewable natural resources is ultimately regulated by the market, strong institutions that define and enforce the necessary legal framework, or other regulatory interventions (setting the appropriate tax level or the appropriate number of tradable permits) are indispensable. Although purely public governance models may seem less important than before, there are times when state governance, in various forms, remains of high relevance, such as in fostering legal and institutional frameworks, or applying certain economic instruments (taxes, tradable rights). We distinguish between two models of public governance: the state governance model; and the decentralized governance model.

State governance

With state governance, we are referring to the traditional form of governing through hierarchy, in which public authority lies with the central government. As outlined in the previous section on the actors, the state is expected to ensure the realization of collective preferences. Since the central state is physically and administratively further distant from its voters and the local context, it may have greater flexibility to also address topics that from a voter's perspective might be less of a priority, notably the provision of public environmental goods and services at the national and global level. Typical (and not exclusive) regulatory instruments include legal and market-oriented measures to shape renewable natural resource policy.

Decentralized public governance

The decentralization of tasks and decision-making power from the central government to local governments is another form of public governance, and it differs profoundly from traditional central government control. The argument for decentralization lies in the assumption that local governments possess greater knowledge of the local needs and have more information on locally feasible actions. As outlined in the previous section, local stewardship can result in greater responsibility regarding local resources and ecosystems, although the direct proximity to constituencies (voters) may also risk a preference for voter-friendly activities (infrastructure projects) over provision of the more "invisible" environmental public good. A distinction is often made between political and administrative decentralization. Compared to political decentralization, which basically consists in greater political participation, administrative decentralization implies greater political, administrative, and financial independence for local governments from central governments. Major administrative decentralization efforts in environmental policy were undertaken in Brazil, for example. Many African countries also have decentralization as a priority, which offers opportunities for environment and natural resource management at the local level.

4.3 Public-private governance models

Public-private governance models attribute a key role to collaborative relations between governments and private actors, i.e. non-governmental organization or private firms. The aim of such co-operative regulation is to make the mutual dependencies among stakeholders productive, e.g. governments benefiting from the problem-solving capacity of private stakeholders by forging strategic alliances with them. The mechanism for change consists in communication, dialogue and negotiations between the stakeholders, expressed in contractual arrangements, including voluntary contracts, agreements and partnerships among the stakeholders. The expectation is that these collaborative governance systems will ultimately allow for more effective environmental policy regulations. Typical examples of such governance models include public-private partnerships or co-management systems.

Public-private partnerships

Public-private partnerships (PPP) are based on contractual arrangements between government and private sector entities for the purpose of providing public goods and services (e.g. infrastructure services, water sewage services, protected-area management). The concept stems from business administration, and the underlying logic for establishing partnerships is that both the public and the private sector have unique characteristics that provide them with comparative advantages in specific aspects of service or project delivery (Loew and McLindon, 2002). Contractual arrangements include service contracts (1-2 years), management contracts (3-5 years), leases (8-15 years), concessions (25-30 years) or build-operate transfer (BOT) arrangements (2-30 years). In return for agreeing to provide the service, the private partner receives payment (in the form of a fee, tariff or user charge) according to certain standards of service and other criteria as specified in the contract. The government is relieved of the financial and administrative burden of providing the service, but it retains an important role in regulating and monitoring the performance of the private partner. PPP are thus not a substitute for strong and effective governance and decision-making by government.

With the renewed concepts about the role of the state, and the decrease of public funds, PPP became a suitable arrangement for serving the interests of both public and private actors. PPP are widely promoted by national and international organizations, including the OECD and the World Bank. One example is the public-private partnership program funded by the Inter-American Development Bank in El Salvador for local economic development of the agricultural sector. Another example of PPP is the partnership between German Technical Assistance (GTZ) and the banana producer Chiquita Brands International in Costa Rica to preserve biodiversity, to promote conservation and to find new income sources for the local population in the northeastern part of the country.

Co-management systems

Co-management schemes pertain to concerted management and/or decision-making between communities or user groups and the state and can be viewed as being between pure-state and pure- communal control (Pomeroy and Berkes, 1997; Kuperan et al., 1996). They are based on contractual arrangements between the state and the user groups. They typically involve the recognition, legitimization of sector- or local-level management systems (even traditional or informal), and a certain degree of community based resource management is a central element of co-management (Pomeroy and Berkes, 1997). Reduction in the authority and responsibility of the central agencies is alleged to result in co-management being a more efficient institutional arrangement for managing natural assets. Criticisms against shared-management approaches to renewable natural resource governance are similar to those expressed for common-property resource (CPR) management, i.e. the difficulty of designing and enforcing adequate institutional arrangements. Nonetheless, co-management systems have received increasing interest from donor agencies for their adequacy in cases of common property resources, such as fisheries or pasture management. In Madagascar, for example, co-management has been successfully applied to the shrimp fisheries sector (Rojat *et al.*, 2004). For further contributions on the application of co-management to renewable natural resources, see for example Baland and Plateau (1996), Sherry and Halseth (2003), or Borrini-Feyerabend *et al.* (2004).

Global public policy networks

Global public policy networks have emerged over the past two decades. In these networks, states, international organizations, civil society actors and private firms are collaborating to achieve what none of the single actors is able to achieve alone (Reinicke and Deng, 2000; Witte et al., 2000). The mechanism of change in these networks is based on platforms of discussion and exchange that ultimately result in regulatory agreements. The World Commission on Dams (WCD), for example, was designed to respond to the operational and participatory governance challenge of generating institutional arrangements and decision-making processes that facilitate sustainable dam construction. WCD has managed to overcome the gridlock among development planners, contracting firms, and environmental groups involved in the construction of large dams. Global public policy networks can play an important role in regulating global public goods (biodiversity conservation, climate change mitigation). Policy makers or donor agencies can opt to collaborate themselves, or they can invite their constituents to join such global public policy networks in the quest for adequate regulatory arrangements.

4.4 Private governance models

Private governance systems refer to regulatory configurations in which private actors play the major role. The state is only indirectly involved by providing the necessary institutional framework through which private governance models can develop. Private systems to govern renewable natural resources continue to emerge, and there are great expectations about their regulatory potential. The emergence of these systems can be linked to the perceived insufficient capacity of the state to respond to the regulatory need. For example, unsatisfied with the public response to biodiversity loss at the local and global level, some NGOs started independently to propose alternative regulatory measures, such as “conservation concessions” (Rice, 2003), or independent certification systems, such as that promoted by the Forest Stewardship Council (FSC). Donor agencies seeking “good governance” of renewable natural resources can promote institutional capacities that facilitate the emergence of, or participation in, private governance systems. Variants of such systems include community governance, corporate social responsibility networks, and non-state market-driven governance.

Community governance[7]

In these systems, the community has the regulatory control, while the state is expected to provide the necessary institutional framework for the communities to develop and execute their control without interference from the state. Based on theoretical insights from institutional economics (Ostrom, 1990) and the theory of collective action (Olson, 1965), these systems are based on common property rights structures, as well as formal or informal (social) contracts and enabling institutions among their members to access and use their common property resources. They are seen as adequate in many developing countries for the welfare of the poorest individuals, as well as for the protection of sensitive and marginal ecosystems (Dasgupta, 1993). However, while the approaches require a strong stake by local communities, most practical examples remain state-led (Allison, 2004). A major challenge lies in the design and enforcement of adequate institutional measures allowing for community governance to function at its best. In addition, community governance systems have to ensure that equity issues are taken into account to avoid traditional leaders or dominant groups excluding parts of the community (e.g. the poorest, or the ones from another clan or lineage). Important actors of these approaches widely promoted since the 1990s include the UK Department for International Development with the *Sustainable Livelihood* concept, the World Bank with the *Community-driven Development* approach, and IUCN’s Working Group on Collaborative Management.

Corporate social responsibility (CSR) networks

Corporate Social Responsibility (CSR) is a global movement in which companies and organizations voluntarily

[7] Although co-management differs from community based management, the operational literature often uses these terms interchangeably to refer to community involvement in resource management.

integrate social and environmental concerns into their operations and reporting practices. Motivations for firms to become CSR-labeled include improved image (signaling), greater business efficiency within firms (employees might feel more respected) and outside of firms (among business partners, with respect to state regulators or civil society organizations). These commitments go beyond the usually prescribed rules and laws and include the voluntary reporting and standardization of business procedures, usually within the scope of a larger network that ultimately controls compliance and sanctions non-compliance. Enforcement occurs through other members of these networks, or the market (i.e. consumers avoiding the products of a business that was wrongly claiming to be environmentally friendly). Examples include the Global Reporting Initiative, a network of firms committed to reporting on their economic, environmental and social performance, or the Global Environmental Management Initiative, an organization of companies dedicated to fostering and achieving global environmental, health and safety excellence. With the objective of more sustainable use of renewable natural resources, policy makers and donor agencies can invite their private-sector constituents involved in the primary sector (agriculture, livestock, fisheries) to opt for CSR measures.

Non-state market-driven governance

Non-state market-driven governance approaches are networks of organized civil society that define and implement standards, which are regulated via market mechanisms while public authorities remain absent (Cashore, 2002). Prominent examples of such networks include the Forest Stewardship Council or the Marine Stewardship Council, which promote certification of products originating from sustainable production operations and for which consumers are willing to pay higher prices. In this approach, the rules (standards, norms) are set by the civil society and regulated by the market (price) mechanism. However, the regulatory potential of non-state market-driven governance systems, such as the FSC, remains subject to debate (Guéneau, 2007). While non-state market-driven governance systems can have substantial political and capacity building power (i.e. sensitize producers and consumers to the role of sustainable resource management practices), the total neglect of public actors can be counter-productive. The reason is that such certification systems rely strongly on the legal and institutional framework in place (e.g. land titling, monitoring systems, legal enforcement measures), which is ultimately under the control of public authorities (Guéneau, 2007). Still, policy advisors or donor agencies can try to promote third-party certification while encouraging public efforts to provide the necessary institutional framework.

5. Policy implications and conclusions

Environmental and natural resource management has evolved rapidly over the last fifteen years. This note provides a survey of the recent developments and discusses their applicability in developing country contexts. In addition to new incentive measures, it is the rise of new actors and new forms of governance that has profoundly shaped the way ecosystem goods and services are regulated today. These developments were also shaped by the shift from a single-resource orientated management approach during the 1960s and 1970s to a more holistic ecosystem-based management approach since the 1990s. They are expected to be further shaped by the Millennium Ecosystem Assessment (2005), which provided additional momentum for the international recognition of the fundamental value of ecosystem services for human wellbeing, and the urgency to act for their conservation. As for policy options and regulatory responses for ecosystem management, we show that there is no single panacea but many tools and forms of governance that each can be the adequate measure for improving renewable natural resource governance, depending on the local conditions and collective preferences.

What are the practical implications for policy makers and donor agencies? In essence, a new question is raised as to which governance structure to promote. Besides the already challenging issue of identifying the adequate resource management objective and appropriate mix of policy measures to promote, policy makers and donor agencies now also face the question of which form of stakeholder participation to pursue. This refers not only to the type and number of actors involved, but also to the type of incentive measures (including institutional preconditions) and to the appropriate spatial scale (local, regional, national) to enable these governance structures to function properly. The adequacy of a given governance structure largely depends on the local economic, social and ecological context. A certain form of resource coordination that works best in one place is not necessarily the best choice in another place. In addition, the interactions between a given governance structure and the overall macroeconomic framework also matter. Alternative governance structures can affect macroeconomic objectives differently, and it appears important for donor agencies to reduce the potential undesired effects beforehand.

In light of these challenges, policy makers and donor agencies seeking to promote “good governance” of renewable natural resources will face several practical questions. Among these, we highlight the following, which we find of particular relevance:

- ***How to reveal collective preferences?*** Knowledge on societal priorities (employment, trade balance, state budget, climate change mitigation), existing constraints (equity aspects, sustainable development criteria), and the interdependencies between them can help inform the sector policy responses (e.g. whether or not to favor resource export policies). In many cases, however, these preferences are only insufficiently known to the public regulator (mainly due to information asymmetries and transaction costs). Standard economic theory assumes that societal preferences are limited to the aggregation of individual preferences. We argue that there may be certain elements, such as environmental health or social equity, that might not be of priority to individuals, yet still valuable for the entire society, thus justifying their pursuit by public policy makers. While the revelation of individual preferences is already a complex task, the disclosure of collective preferences beyond aggregated individual preferences is even more challenging. However, knowing these collective preferences (and their implications) is highly relevant for the proper design of environmental policy. Coherent methods to

reveal these collective preferences – under the given time and cost constraints – could therefore substantially increase the quality of (donor) policy advice on adequate forms of environmental governance.

- ***How to design suitable policy responses?*** Policy makers and donor agencies also face the challenge of efficiently allocating their resources among several policy options. In light of emerging forms of environmental governance, the question refers not only to which policy measure to promote, but also to which actor configuration to advocate and which institutional underpinnings (organizations, contracts, partnerships) to support. Proper design of environmental policy instruments is a challenge on its own, and there is a vast literature on the subject (Sterner, 2003; Godard, 1991, 2000). The choice regarding which of the various stakeholders and types of stakeholder involvement to promote is part of the more recent demands, and research on the topic remains largely case-study specific. This is partly due to the high degree of context-dependency, since the social, economic and environmental facets of local contexts greatly influence the adequacy of alternative governance structures, not to mention the other typical characteristics of developing country contexts, such as weak state institutions, poor market functioning or lack of resources. Again, a coherent framework for analyzing a given context, the actors and incentive structures could contribute to improved advice as to which form of environmental governance to pursue.

Because of the plurality of governance options, the heterogeneity of local contexts and the multiple interactions possible between sector policies and the macroeconomic framework, we see a need for a comprehensive policy evaluation framework to assist policy makers and donor agencies – in consultation with the stakeholders – in identifying suitable, context-specific forms of renewable natural resource governance. The conceptual framework of multi-criteria analysis could be one way of addressing the above outlined questions. This endeavor could further follow up on previous efforts, including the “situation analysis” framework developed by the German Development Agency (Fischer et al., 2004) and the diagnostic and planning tool for forest governance developed by IIED (Mayers et al., 2002). Such policy evaluation frameworks could then contribute substantially to more sound and better-informed decisions on how to govern renewable natural resources in coherence with the overall societal objectives.

References

Allison, E. H. (2004), "Consultancy on Policies for Inland Fisheries Co-Management", Consultancy Report, UK Department for International Development (DFID) and Food and Agricultural Organization (FAO).

Andersen, M. S. (2006), "The Use of Economic Instruments for Environmental Policy – A Half Hearted Affair", Internet Publication, International Institute for Sustainable Development (www. iisd.ca/consume/skou.html, accessed 18 June 2006).

Baland, J.-M. and J.-P. Platteau (1996), *Halting Degradation of Natural Resources – Is there a role for rural communities?* Food and Agricultural Organization (FAO) and Oxford University Press, New York.

Barbier, E. (1989), *Economics, Natural Resource Scarcity and Development – Conventional and alternative views*, Earthscan Publications, London.

Baumol, W.J. and W. E. Oates (1988), *The Theory of Environmental Policy*, Cambridge University Press, Cambridge.

Baumol, W. J. (1972), "On taxation and the control of externalities", *American Economic Review*, 63(3): 307-322.

Baumol, W.J. and W. E. Oates (1971), "The use of standards and prices for the protection of the environment", *Swedish Journal of Economics*, 73: 42-54.

Barzel, Y. (1989), *The Economic Analysis of Property Rights*, Cambridge University Press, New York.

Bizer, K. and R. Jülich (1999), "Voluntary Agreements: Trick or Treat?", *European Environment*, 9(2): 59-66.

Bojö, J. and R.C. Reddy (2003), "Status and Evolution of Environmental Priorities in the Poverty Reduction Strategies – An Assessment of Fifty Poverty Reduction Strategy Papers", Environmental Economics Series No. 93, World Bank, Washington D.C.

Börkey, P., Glachant, M. and F. Lévêque (2000), "Voluntary Approaches for Environmental Policy in OEDC Countries: An Assessment", Centre d'économie industrielle (CERNA), Ecole Nationale Supérieure des Mines de Paris, Paris (www.cerna.ensmp.fr/Documents/PBMGFL-OECDVAs.pdf).

Bolton, P. and M. Dewatripont (2005), *Contract Theory*, MIT Press.

Borrini-Feyerabend, G., Pimbert, M., Farvar, M. T., Kothari, A. and Y. Renard (2004), *Sharing Power: Learning by doing in co-management of natural resources throughout the world*, IIED and IUCN/CEEP/CMWG, Cenesta, Teheran.

Bovenberg, A.L. and R.A. de Moorij (1994), "Environmental levies and distortionary taxation", *American Economic Review,* 94: 1085-89.

Brown, G.M. (2000), "Renewable Natural Resource Management and Use without Markets", *Journal of Economic Literature*, 18: 875-914.

Bromley D. (1991), *Environment and Economy: Property Rights and Public Policy*, Oxford University Press, Oxford.

Brousseau, E. and J.M. Glachant (2002), "Contract Economics and the Renewal of Economics", in Brousseau, E. and J.M. Glachant (editors), *The Economics of Contracts: Theories and Applications*, Cambridge University Press, Cambridge.

Brousseau, E. (1995), "De la science du marché à l'analyse économique des formes de coordination", *Les Cahiers Français*, 272: 54-63.

Cashore, B. (2002), "Legitimacy and the Privatization of Environmental Governance: How Non-State Market Driven (NSMD) Governance System Gain Rule-Making Authority", *Governance: An International Journal of Policy, Administration and Institutions*, 15(4): 503-529.

Charles, A. (1983), "Optimal fishery investment under uncertainty", *Canadian Journal of Fisheries and Aquatic Sciences*, 40: 2080-2091.

Chomitz, K.M. (2004), "Transferable development rights and forest protection: an exploratory analysis", *International Regional Science Review*, 27(3): 348–373.

Chomitz, K. M., Thomas, T. S., and A. S. Brandão (2004), "Creating markets for habitat conservation when habitats are heterogeneous", *World Bank Policy Research Paper*, No. 3429.

Clark, C.W. (1976), *Mathematical Bioeconomics: The optimal management of renewable resources*, John Wiley and Sons.

Coase, R. (1988), *The firm, the market and the law*, University of Chicago Press, Chicago.

Coase, R. (1960), "The problem of social cost", *Journal of Law and Economics*, 3(1): 1-44.

Coase, R. (1937), "The nature of the firm", *Economica*, 4(16): 386-405.

Cochrane, K. L. (2002), "A Fishery Manager's Guidebook – Management Treasures and their Application", FAO Fisheries Technical Paper 424, (www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/005/Y3427E/y3427e07.htm).

Common, M. (1995), *Sustainability and policy: Limits to Economics*, Cambridge University Press, Cambridge.

Cropper, M.L. and W.E. Oates (1992), "Environmental Economics: A Survey", *Journal of Economic Literature*, 30: 675-740.

Dales, J. H. (1968), Pollution, *Property and Prices*, University of Toronto Press, Toronto.

Dasgupta, P. (1993), *An inquiry into well-being and destitution*, Clarendon Press, London

Demsetz, H. (1967), "Toward a Theory of Property Rights", *American Economic Review, Papers and Proceedings*, 57: 347-359.

Demsetz, H. (1964), "The Exchange and Enforcement of Property Rights", *Journal of Law and Economics*, 7: 11-26.

EEA (1999), “Environmental Agreements - Environmental Effectiveness”, *Environmental issue report*, No. 3, European Environment Agency, Copenhagen (http://reports.eea.eu.int/92-9167-052-9/en).

Englin, J.E. and M. S. Klan (1990), “Optimal taxation: Timber and Externalities”, *Journal of Environmental Economics and Management*, 18: 263-275.

FAO (1997), “Zonificación Agro-Ecológica”, *FAO Soils Bulletin* 73 (www.fao.org/documents/show_cdr.asp?url_file=/docrep/W2962S/W2962S00.htm).

Faustman, M. (1849), “Berechnung des Werthes, welchem Waldboden sowie noch nicht haubare Holzbestände für die Waldwirtschaft besitzen”, *Allgemeine Forst- und Jagt-Zeitung*, 25: 441-455.

Faucheux, S. and J.-F. Noël (1995), *Économie des Ressources Naturelles et de l’Environnement*, Armand Colin Éditeur, Paris.

Ferraro, P. J. and R. D. Simpson (2002), “The Cost-Effectiveness of Conservation Payments”, *Land Economics*, 78(3): 339-353.

Ffolliot, P. F., Bojorquez-Tapia, L. A., and M. Hernandez-Narvaez (2001), *Natural Resource Management Practices – A Primer*, Iowa State Press, Ames.

Fischer, A., Petersen, L. and W. Huppert (2004), *Natural resource and governance: Incentives for sustainable resource use*, Manual, Environment and Infrastructure Division, German Development Cooperation (GTZ), Eschborn.

Gillinson, S. (2004), “Why Cooperate? A Multi-Disciplinary Study of Collective Action”, *Working Paper* 234, Overseas Development Institute, London.

Glachant, M. (2002), “The political economy of emission tax design in environmental policy”, *Working Paper* 96, Fondazione Eni Enrico Mattei, Trieste.

Glachant, M. (2001), “Les instruments de politique environnementale en matière de contrôle de la pollution”, Cours de Microéconomie de l’environnement - DEA Economie de l’Environnement et des Ressources Naturelles, Centre d’économie industrielle (CERNA), Paris.

Goeschl, T. and T. Lin (2004), “Biodiversity conservation on private lands: information problems and regulatory choices”, *Working Papers of the Finnish Forest Research Institute* (www.metla.fi/julkaisut/workingpapers/2004/mwp0001.htm).

Godard, O. (2003), “Sustainability Impact Assessment and integrated modeling in controversial universes: a background”, SUSTRA Workshop – UCL, Louvain La Neuve, 27-28 March 2003.

Godard, O. (2000), “La conception et l’application des permis transférables nationaux dans les politiques d’environnement”, Organisation of Economic Cooperation and Development (OECD), Paris (eurequa.univ-paris1.fr/S%E9minaires-GT-Eurequa/seminairePEN/pdf/Principaux/Godard-OCDE-Livre-geei9912Fa-01.pdf, accessed 17/2/2007).

Godard, O. (1991), “Possibilités, limites et conditions de mise en oeuvre efficace des instruments économiques des politiques de l’environnement dans les pays en transition vers l’économie de marché”, paper presented at the seminar on “l’utilisation

des instruments économiques pour la protection de l'environnement dans les economies en transition vers l'économie de marché", Organisation for Economic Co-operation and Development (OECD), Paris 16-18 December.

Grumbine, R.E. (1994), "What is ecosystem management?", *Conservation Biology*, 8: 27-39.

Guéneau, S. (2007), "Certification as a new private global forest governance system: the regulatory potential of the Forest Stewardship Council", paper presented at the Conference "Non-State Actors as Standard Setters: The Erosion of the Public-Private Divide", Basel Institute on Governance, Basel, 8-9 February 2007.

Hanley, N., Shogren, J.F. and B. White (1997), *Environmental Economics in Theory and Practice*, Oxford University Press, New York and Oxford.

Hardin, G. (1968), "The Tragedy of the Commons", Science,162: 1243-1248.

Hamilton, K, Ruta, G., Markandya, A., Pedroso, S., Silva, P., Ordoubadi, M., Lange, G.M., Tajibaeva, L., Gronnevet, L., and M. Dyoulgerov (2006), *Where is the wealth of nations? Measuring capital for the 21st century*, World Bank, Washington DC.

Karsenty, A. (2004), "Des rentes contre le développement? Les nouveaux instruments d'acquisition mondiale de la biodiversité et l'utilisation des terres dans les pays tropicaux", *Monde et Développement*, 127(3): 59-72.

Karsenty, A. (2002), "Le rôle controversé de la fiscalité forestière dans la gestion des forêts tropicales – L'état du débat et les perspectives en Afrique centrale", *Cahiers d'économie et sociologie rurales* 64.

Kuperan, K., Mustapha N. and R. Pomeroy (1996), "Transaction costs and fisheries co-management", Working paper, Fisheries Co-Management Website (http://www.co-management.org/download/wp15.pdf , 16/06/06).

Laffont, J.J. and D. Martimort (2001), *The Theory of Incentives: The Principal-Agent Model*, Princeton University Press.

Leruth, L, Paris, R. and I. Ruzicka (2001), "The Complier-Payer Principle: The Limits of Fiscal Approaches Toward Sustainable Forest Management", *IMF Staff Papers*, Vol. 48, No 2.

Libecap, G. (1991), *Contracting for Property Rights*, Cambridge University Press, Cambridge.

Loew, J. and M. McLindon (2002), "A P3 Primer – Why are countries interested in P3?", Institute for Public Private Partnerships (http://www.ip3.org/pub/publication002.htm).
Markandya, A., Perelet, R., Mason, P. and T. Taylor (2001), *Dictionary of Environmental Economics*, Earthscan, London and Sterling.

Martimort, D. (2005), "Contract Theory", in Arrow, K., Blume, L. and S. Durlauf (eds.): The New Palgrave, forthcoming (www.idei.fr/doc/by/martimort/contract_theory.pdf, accessed 06/08/06).

Maxwell, J.W., Lyon T.P. and C. Hackett (1998), "Self Regulation and Social Welfare: The Political Economy of Corporate Environmentalism", Nota di Lavoro, Fondazione Eni Enrico Mattei, 55,98.

Mayers, N., Bass, S. and D. Macqueen (2002), *The Pyramid – A diagnostic and planning tool for good forest governance*, report prepared for the World Bank WWF Alliance for Forest Conservation and Sustainable Use, International Institute for Environment and Development, London.

Millennium Ecosystem Assessment (2005), *Ecosystems and Human Well-being: Synthesis*, Island Press, Washington D.C. (http://www.maweb.org/en/products.aspx).

Morell, M. (2001), "Governance principles for concessions and contracts in public forests", *FAO Forestry Paper 139*.

Moxey, A., White, B. and A. Ozanne (1999), "Efficient contract design for agrienvironment policy", *Journal of Agricultural Economics*, 50(2): 187-2002.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. and Kent, J. (2000), Biodiversity hotspots for conservation priorities", *Nature*, 403: 853–858.

North, D.C. (1990), *Institutions, Institutional Change and Economic Performance*, Cambridge University Press, Cambridge.

Oates, W.E. (1995), "Green taxes: Can we protect the environment and improve the tax system at the same time?", *Southern Economic Journal*, 61: 915-22.

OECD (1999), *Handbook of Incentive Measures for Biodiversity: Design and Implementation*, OECD, Paris.

OECD (1975), *The Polluter Pays Principle: Definition, Analysis, Implementation*, Organisation for Economic Co-operation and Development, Paris.

Olson, M. (1965), *The Logic of Collective Action*, Harvard University Press, Cambridge.

Ostrom, E. (1990), *Governing the Commons*, Cambridge University Press, Cambridge.

Pagiola, S., Arcenas, A. and G. Platais (2005), "Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America", *World Development*, 33(2): 237-255.

Pagiola, S., Agostoni, P., Gobbi, J., de Haan, C., Ibrahim, M., Murgueitio, E., Ramírez, E., Rosales, M. and J. P. Ruiz (2004), "Paying for biodiversity conservation services in agricultural landscapes", *Environment Department Paper 96*, Washington D.C.

Pagiola, S., Bishop, J. and N. Landell-Mills (2002), *Selling Forest Environmental Services – Market-based Mechanisms for Conservation and Development*, Earthscan, London and Sterling.

Paris, R. and I. Ruzicka (1991), "Barking up the Wrong Tree: The role of rent appropriation in sustainable tropical forest management", ADB Environment Office, Occasional Paper, Manila.

Pearce, D. (2002), "An intellectual history of environmental economics", *Annual Review of Energy and the Environment*, 27: 57-81.

Pigou, A.C. (1920), The Economics of Welfare, Library of Economics and Liberty, Retrieved February 22, 2006 from the World Wide Web: http://www.econlib.org/library/NPDBooks/Pigou/pgEW1.html.

Polasky, S. (2001), "Investment, information collection and endangered species conservation on private land", in Shogren, J. F. and J. Tschirhart (eds.): *Protecting endangered species in the United States: Biological needs, political realities, economic choices*, Cambridge University Press, Cambridge.

Pomery, R. S. and F. Berkes (1997), "Two to tango: The role of government in fisheries co-management", Marine Policy, 21(5): 465-480.

Reinecke, W.H. and F. Deng (2000), CRITICAL CHOICES — *The United Nations, Networks, and the Future of Global Governance*, International Development Research Centre, Ottawa.

Rice, E. (2003), "Conservation Concessions – Concept Description", presentation at the 5th World Parks Congress, Durban (www.conservationfinance.org/WPC/WPC_documents/Apps_09_Rice_v2.pdf).

Richter, R. And E. G. Furubotn (2003), *Neue Institutionenökonomik*, 3rd edition, Mohr Siebeck, Tübingen.

Rodriguez, C. M. (2006), "Les paiements pour les services environnementaux : l'exemple réussi du Costa Rica", presentation at the French development Agency (AFD), Paris, 20 September 2006.

Rogowski, R. and T. Wilthagen (1994), *Reflexive Labour Law*, Kluwer, Deventer.

Rojat, D. (2006), "Investir dans la gestion des ressources renouvelables", powerpoint presentation to the Master degree students at Centre d'Etudes et de Recherches pour le Développement International, AFD-Cefeb, Université Senghor d'Alexandrie, Egypt (International Francophone Organization). Available from rojatd@afd.fr.

Rojat, D., Rajaosafara, S. and C. Chaboud (2004), "Co-Management of the Shrimp Fishery in Madagascar", paper presented at the *International Institute of Fishery Economics and Trade (IIFET)*, Tokyo (Japan).

Rojat, D. (1991), "Pâturages communs : modélisation bio-économique et gestion des systèmes pastoraux", Etudes et Synthèses n°37, Centre International de Recherche Agronomique pour le Développement/Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, Montpellier (France).

Salanié, B. (1997), *The Economics of Contracts*: A Primer, MIT Press.
Schmidt, K.M. (2005), "Vertragstheorie", in Pfingsten, A. (ed.): *Handwörterbuch der Betriebswirtschaft*, forthcoming.

Segerson, K. (1988), "Uncertainty and incentives for nonpoint pollution control", *Journal of Enviromental Economics and Management*, 15: 87-98.

Sherry, E. and R. Halseth (2003), "Joint Resource Management Alternatives – A bibliography of national and international resources", University of Northern British Columbia.

Shogren, J. F. and J. Tschirhart (2001), *Protecting endangered species in the United States: Biological needs, political realities,*

economic choices, Cambridge University Press, Cambridge.

Simpson, R. and R.A. Sedjo (1996), "Paying for the conservation of endangered ecosystems: a comparison of direct and indirect approaches, *Environment and Development Economics*, 1: 241-257.

Smith, R. and J. Shogren (2002), "Voluntary Incentive Design for Endangered Species Protection", *Journal of Environmental Economics and Management*, 43: 169-187.

Sterner, T. (2003), *Policy Instruments for Environmental and Natural Resource Management*, Resources for the Future, Washington D.C.

Teubner, G. (1993), *Law as an Autopietic System*, Blackwell, Oxford.

Weitzman, ML (1974), Prices vs. Quantities, *Review of Economic Studies*, 41: 477-491.

Williamson, O.E. (2005), "The Economics of Governance", mimeo, University of California, Berkeley.

Williamson, O. E. (2000), "The New Institutional Economics: Taking Stock, Looking Ahead", *Journal of Economic Literature*, 18: 595-613.

Williamson, O.E. (1981a), "The Modern Corporation: Origins, Evolution, Attributes", *Journal of Economic Literature*, 19(4): 1537-1568.

Williamson, O.E. (1981b): "The Economics of Organization: The Transaction Cost Approach", *The American Journal of Sociology*, 87(3): 548-577.

Williamson, O.E. (1973): "Market and Hierarchies: Some Elementary Considerations", *American Economic Review*, 63: 316-25.

Witte, J.M., Reinicke, W.H. and T. Brenner (2000), "Beyond Multilaterism: Global Public Policy Networks", *International Politics and Society*, 2.

Wu, J. and B. Babcock (1995), *Optimal design of a voluntary green payment program under asymmetric information*, Ames.
Wunder, S. (2005), "Payments for environmental services: Some nuts and bolts", CIFOR Occasional Paper 42, Center for International Forestry Research, Bogor.

Xapapadeas, A. (1995), "Environmental Policy under Imperfect Information: Incentives and Moral Hazard", *Journal of Environmental Economics and Management*, 20(2): 113-126.

Liste des Documents de travail déjà parus

Document de travail n° 1 – A Poverty Forecasting Tool: A Case-Study of Senegal
Thierry Latreille, AFD - Janvier 2005.
En anglais uniquement.

Document de travail n° 2 - Les OMD et l'aide de cinquième génération
Jean-David Naudet, AFD - Mai 2005.

Document de travail n° 3 - Biens publics mondiaux et développement : De nouveaux arbitrages pour l'aide ?
Sarah Marniesse, AFD - Septembre 2005.

Document de travail n° 4 - Agir en faveur des acteurs et des sociétés fragiles
Jean-Marc Châtaigner et François Gaulme, AFD - Septembre 2005.
Egalement disponible en anglais.

Document de travail n° 5 - La filière riz au Mali : compétitivité et perspectives de marché
Pierre Baris, Jean Zaslavsky, Serge Perrin - Septembre 2005.

Document de travail n° 6 - Turquie : Risque systémique bancaire et vulnérabilités macro-financières
François-Xavier Bellocq et Vincent Caupin, AFD - Octobre 2005.

Document de travail n° 7 - La Tunisie et le marché euro-méditerranéen du tourisme
Jean-Raphaël Chaponnière, CEPN et AFD et Marc Lautier, CARE, Université de Rouen - Septembre 2005.

Document de travail n° 8 - Le développement, une question de chances ? A propos du rapport sur le développement dans le monde 2006 « Equité et Développement »
Jean-Pierre Cling, Denis Cogneau, Jacques Loup, Jean-David Naudet, Mireille Razafindrakoto, François Roubaud, DIAL - Septembre 2005.
Egalement disponible en anglais.

Document de travail n° 9 - Aid Selectivity According to Augmented Criteria
Jacky Amprou, AFD, Patrick Guillaumont, Sylviane Guillaumont Jeanneney, CERDI - Novembre 2005.
En anglais uniquement.

Document de travail n° 10 - Le Cambodge rural face à la pauvreté : contribution à la réflexion sur les dynamiques agraires et le changement social
Julien Calas, AFD Phnom-Penh - Janvier 2006.

Document de travail n° 11 - Vietnam : les vulnérabilités macro-financières associées au processus d'émergence
François-Xavier Bellocq et Jean-Raphaël Chaponnière, AFD - Janvier 2006.
Egalement disponible en anglais.

Document de travail n° 12 - Chine : la croissance et ses déséquilibres
François-Xavier Bellocq et Jean-Raphaël Chaponnière, AFD - Janvier 2006.

Document de travail n° 13 - Legs colonial et gouvernance contemporaine (Note de synthèse)
Jean-François Bayart, Romain Bertrand, Thornike Gordadze, Béatrice Hibou et Françoise Mengin, FASOPO (Fonds d'analyse des sociétés politiques) - Mars 2006.

Document de travail n° 14 - Apprendre pour vivre et travailler : contribution du GEFOP au Rapport sur le développement dans le monde 2007 de la Banque mondiale
Réseau GEFOP (Synthèse rédigée par R. Walther) - Mars 2006.
Egalement disponible en anglais.

Document de travail n° 15 - La formation professionnelle en secteur informel (Note de problématique)
Richard Walther, consultant ITG - Mars 2006.
Egalement disponible en anglais.

Document de travail n° 16 - La formation professionnelle en secteur informel - Rapport sur l'enquête terrain au Maroc
Richard Walther, consultant ITG - Juin 2006.
Egalement disponible en anglais.

Document de travail n° 17 - La formation professionnelle en secteur informel - Rapport sur l'enquête terrain au Cameroun
Richard Walther, consultant ITG, avec le concours d'Ewa Filipiak et de Christine Uhder, AFD - Juillet 2006.
Egalement disponible en anglais.

Document de travail n° 18 - Rapport sur le risque-pays du Maroc
Jérôme Sgard, Cepii et Université de Paris-Dauphine - Juin 2006.

Document de travail n° 19 - La formation professionnelle en secteur informel - Rapport sur l'enquête terrain au Bénin
Richard Walther, consultant ITG, avec le concours d'Ewa Filipiak et de Christine Uhder - Juillet 2006.
Egalement disponible en anglais.

Document de travail n° 20 - Institutions, développement et pauvreté
Alice Sindzingre, CNRS, EconomiX, Université Paris X-Nanterre ; School of Oriental and African Studies (SOAS), Université de Londres - Juillet 2006.
Egalement disponible en anglais.

Document de travail n° 21 - La formation professionnelle en secteur informel - Rapport sur l'enquête terrain au Sénégal
Richard Walther, consultant ITG, avec le concours d'Ewa Filipiak et de Christine Uhder - Juillet 2006.
Egalement disponible en anglais.

Document de travail n° 22 - Les fondations philanthropiques américaines, acteurs émergents de la mondialisation et piliers du dialogue transatlantique.
Benoît Chervalier, German Marshall Fund of the United States, et Joseph Zimet, AFD - Juillet 2006.
Egalement disponible en anglais.

Document de travail n° 23 - L'AFD et ses partenaires : La dimension culturelle
Philippe d'Iribarne, CEREB - CNRS - Août 2006.

Document de travail n° 24 - Secteur de l'eau au Sénégal - Un partenariat équilibré entre acteurs publics et privés pour servir les plus démunis ?
Aymeric Blanc, département de la Recherche, AFD, et Cédric Ghesquières, consultant junior, AFD - Août 2006.

Document de travail n° 25 - Décentralisation et politique de l'eau gratuite en Afrique du Sud: Quelle place pour le secteur privé ?
Aymeric Blanc, département de la Recherche, AFD, et Cédric Ghesquières, consultant junior, AFD - Août 2006.

Document de travail n° 26 - L'intégration des programmes d'aide alimentaire aux politiques de développement du Niger : le cas de la crise alimentaire 2004-2005.
Dorothée Chen et Nicolas Meisel, département de la Recherche, AFD, en partenariat avec DIAL - Septembre 2006.
Egalement disponible en anglais.

Document de travail n° 27 - Proposition d'organisation des outils de gestion du risque de marché au bénéfice des filières cotonnières africaines
Jean Cordier, Agrocampus Rennes - Septembre 2006.

Document de travail n° 28 - Les privatisations en zone franc – synthèse des travaux du groupe de travail MINEFI/AFD
Aymeric Blanc, département de la Recherche, AFD - Septembre 2006.

Document de travail n° 29 - Out of the financing trap? Financing post-conflict countries and LICUSs
Marc Raffinot, Université-Dauphine, et Christine Rosellini, DIAL, Paris - Octobre 2006.
En anglais uniquement.

Document de travail n° 30 - La formation professionnelle en secteur informel - Rapport sur l'enquête terrain en Afrique du Sud
Richard Walther, ITG Consultant, Ewa Filipiak, département de la Recherche, AFD, et Christine Uhder, AFD - Octobre 2006.
Egalement disponible en anglais.

Document de travail n° 31 - The Brain Drain: What Do We Know?
Frédéric Docquier, FNRS and IRES, Université Catholique de Louvain and World Bank - Khalid Sekkat, DULBEA, Université Libre de Bruxelles - Octobre 2006.
En anglais uniquement.

Document de travail n° 32 - Les délocalisations françaises vers la Turquie
Julien Gourdon, CERDI, Université d'Auvergne - Décembre 2006.

Document de travail n° 33 - Capital naturel et développement durable en Afrique
Pierre-Noël Giraud, CERNA, Centre de recherche en économie industrielle, Ecole nationale supérieure des Mines de Paris, Denis Loyer, AFD - Décembre 2006.
Egalement disponible en anglais.

Document de travail n° 34 - La formation professionnelle en secteur informel Rapport sur l'enquête terrain en Ethiopie
Richard Walther, Consultant ITG - Novembre 2006.
Egalement disponible en anglais.

Document de travail n° 35 - La formation professionnelle en secteur informel Rapport sur l'enquête terrain en Angola
Richard Walther, Consultant ITG - Novembre 2006.
Egalement disponible en anglais et en portugais.

Document de travail n° 36 - Les accords de partenariat économique : des accompagnements nécessaires
Anna Lipchitz, département de la Recherche, AFD - Janvier 2007.
Egalement disponible en anglais.

Document de travail n° 37 - Energie du Mali, ou les paradoxes d'un « échec retentissant »
Béatrice Hibou, CNRS - CERI, Olivier Vallée, Consultant, AFD - Janvier 2007.

Document de travail n° 38 - Public Private Partnerships in Water and Electricity in Africa
Emmanuelle Auriol, ARQADE and IDEI Toulouse Sciences Economiques, Aymeric Blanc, département de la Recherche, AFD - Janvier 2007.
En anglais uniquement.

Document de travail n° 39 - Economic Partnership Agreements and Regional Trade Flow Dynamics: The ECOWAS Case
Benoît Faivre Dupaigre, Vanessa Alby-Flores, Borgui Yerima, Ann Vourc'h, Anna Lipchitz, Philippe Chedanne - Mars 2007.
En anglais uniquement.

Document de travail n° 40 - La Régie des eaux de Phnom Penh : un modèle de gestion publique efficace
Aymeric Blanc et Alain Riès, département de la Recherche, AFD - Mai 2007.

Document de travail n° 41- Répartition des gains dans les partenariats public-privé : effets comparés des modalités d'assiette d'une redevance de concession
Olivier Ratheaux, AFD - Juin 2007.

Document de travail n° 42 - Potential Financial Frameworks for a Sustainable UNEO
Helle Husum, COWI, Erik Brander, COWI, Suzanne A.K. Steensen, COWI, et Emmanuelle Lachaussée, AFD - Juin 2007
En anglais uniquement.

Document de travail n° 43 - La concession des aéroports de Madagascar : une privatisation en trompe-l'œil ?
Aymeric Blanc, département de la Recherche, AFD, et Olivier Gouirand, AFD - Août 2007.

Document de travail n° 44 - La concession du chemin de fer du Cameroun : les paradoxes d'une réussite impopulaire
Aymeric Blanc, département de la Recherche, AFD, et Olivier Gouirand, AFD - Août 2007.

Document de travail n° 45 - Analyse rétrospective de la crise alimentaire au Niger en 2005
Jean-Pierre Olivier de Sardan, LASDEL, avec la participation de M. Ali Bako, E. Guillermet, O. Hamani, Y. Issa, M. Koné et M. Moha - Septembre 2007.

Document de travail n° 46 - Une nouvelle base de données institutionnelles : « Profils Institutionnels 2006 »
Nicolas Meisel, département de la Recherche, AFD et Jacques Ould Aoudia, DGTPE - Septembre 2007
Egalement disponible en anglais.

Saisie / mise en page : Anne-Elizabeth COLOMBIER

ISSN 1954-3131