

NEF working paper

Ownership models for sustainable natural resource governance

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Summary

Whether forests, fisheries, pasture land, or the global climate, natural resources provide ecosystem services that sustain human life. Moreover, they directly provide a livelihood for people in all parts of the world. However, many natural resources that were previously perceived as unlimitedly abundant are now in sharp decline. In a world of increasingly scarce natural resources, scholars have underscored the importance of ownership models for sustainable resource governance.

There is general consensus that any form of ownership (and thus allocation of responsibility over a resource) is preferable to no ownership (*res nullius*). The importance of ownership models can be illustrated by observing cases in which ownership is not well defined or is inexistent. In such 'open access' cases it is common to find that the resource is exploited in a way that is neither sustainable nor equitable – the future of the resource and those that benefit from it is imperilled. This situation has been popularly characterised as the 'tragedy of the commons'.

A central remaining question is how these ownership models should be set up. While there is a lot of experience and knowledge on the maximal economic exploitation of natural resources, there is little experience and knowledge on the institutionalisation of sustainable resource governance.

In this report it is argued that none of the ownership models can *per se* be a panacea for sustainable resource governance, but that institutional design makes the critical difference. This argument is supported by 11 case studies showing successful and failing cases for each ownership model and thereby discerning factors for successful institutional design.

Private ownership of natural resources

Ronald Coase argues that in cases where the impacts of one resource-user affects outcomes for another user, an economically efficient solution can be reached by assigning property rights to either of the users and allowing them to bargain. He argues that the efficiency of the solution does not depend on who receives the property rights, although the distribution of costs and benefits does. Crucially, for this efficient outcome to be realised two conditions must exist: (1) the property rights must be clearly defined and (2) few impediments to the bargaining process exist.

The case studies examined demonstrate how factors of institutional design in similar contexts have led to contrasting outcomes.

First, two cases of Coasian approaches to conservation (the reintroduction of wolves to the Yellowstone National Park and the privatisation of the management of the

Oak Ridges Moraine recreational area) are compared in order to point out key factors for successful institutional design. Secondly, two cases of privatisation of catching allowances in fisheries (Denmark and Iceland), with relatively similar starting conditions are compared to explore further factors for successful institutional design for sustainable resource governance. The analysis shows that, beyond the Coasian criteria in the case studies, several other factors matter for successful private ownership models for sustainable resource governance: transparency and accountability; institutionalisation of the long-term sustainable management; respect of scientific optima; as well as social inclusion. Figure 1 summarises the results.

<i>Case study</i>	<i>Wolf reintroduction, Yellowstone Park, USA</i>	<i>Oak Ridges Moraine, Canada</i>	<i>Individual Transferable Quota System, Denmark</i>	<i>Individual Transferable Quota System, Iceland</i>
Criteria for effective private ownership				
<i>Type of externality/ resource</i>	<i>Conservation versus damage to cattle</i>	<i>Conservation versus preferred investment in other policy areas</i>	<i>Fish stock stability versus income from fishing</i>	
The resource was understood properly and property rights could be clarified	yes	no	yes	no
Low transaction costs are associated to the bargaining process of identifying private rights and obligations	relatively low	yes	no	yes
Bargaining process allows a Pareto efficient outcome	yes	yes	yes	yes
In spite of privatisation of rights or costs, transparency and accountability are guaranteed	yes	no	yes	yes
A mechanism to guarantee and enforce long-term sustainability of resource use is available	no	no	yes	no
Compliance with scientific optimum is guaranteed and readjustments to the scientific optimum is possible	yes	no	yes	no
Social justice and inclusion of all relevant stakeholders is guaranteed	yes	no	yes	no

Figure 1. Identified decisive institutional design criteria for sustainable resource governance in the context of private ownership of natural resources.

Community ownership of natural resources

Elinor Ostrom provides the seminal study on collective ownership and management of natural resources and identifies the major criteria for successful institutional design for community ownership models.

The relevance of these factors could be illustrated by four case studies and additional criteria for the specific cases could be found. In a first case, the governance of the common pasture land of the mountain community in Törbel in the 1970s is a successful model of community ownership, compared to the failing sustainable collective governance in Törbel today. Through this comparison the adaptability of institutions to changing sociocultural norms and non-heterogeneous populations were underscored as additional factors.

In a second step, two quite similar community governance models for fisheries were analysed. While the Mar de Lira *cofradía* in Spain has been quite successful in institutionalising sustainable fish stock management, a similarly small fisheries community in Turkey has turned into a textbook example of failing community management. All of Ostrom’s criteria apply in explaining why one of the two cases

resulted in a total failure, while both had similar starting conditions. Furthermore, the Mar de Lira case illustrates why independent economic viability of the common institution is crucial. Figure 2 summarises the results.

<i>Case study</i>	<i>Törbel, Switzerland (in 1976)</i>	<i>Törbel, Switzerland (in 2006)</i>	<i>Mar de Lira, Spain</i>	<i>Bodrum, Turkey</i>
Criteria for effective community ownership				
<i>Type of externality/ resource</i>	<i>Competition for and degradation of pasture land</i>		<i>Direct competition for and degradation of fish stocks</i>	
Clear boundaries	yes	yes	yes	no
Congruent rules	yes	no	yes	no
Collective choice arenas	yes	no	yes	no
Monitoring	yes	weak	yes	no
Graduate sanctions	yes	yes	yes	no
Conflict-resolution mechanism	yes	yes	yes	no
Formally recognised rights to organise	yes	no	yes	weak
Nested unit (taking scale into account)	NR	yes	yes	no
Adaptability of institutions	seemed sufficient	no	weak	no
Institutions reflecting local socio-cultural norms and traditional forms of organisation	yes	no	yes	no
Economic viability	yes	no	no	no

* NR = was not relevant in specific context

Figure 2. Identified decisive institutional design criteria for sustainable resource governance in the context of community ownership of natural resources.

Public ownership of natural resources

In general, public ownership is best suited to resources that have one or more of the following qualities: a large geographical scope, a strong public (or even global) good nature, a large number of heterogeneous exploiters, or an associated ecosystem service that is particularly vital. In theory, a government will manage the resource in the public interest, so that those who would deplete that resource against that public interest must bear the cost of doing so. In practice, two key aspects of public resource management are critical: (1) whether the state has the capacity and legitimacy to enforce restrictions on access and (2) the appropriate design of the rules and policies that govern that access.

A comparison between Haiti and the Dominican Republic is a striking example of countries with similar endowments in natural resources (in this case, forests) and completely different outcomes in terms of sustainable resource governance. The analysis shows that while historical conditions play a key role for successful governance, eventually the design of institutions and policy choices that have been made in the recent past are central factors for divergence. Furthermore, a brief description of the successful reduction of deforestation in Brazil illustrates that there is no path dependency in natural resource exploitation, but that governments with sufficient institutional capacity can make a substantial difference and set up the

policies that institutionalise sustainable resource governance if they are determined to do so. Figure 3 summarises the results.

<i>Case study</i>	<i>Haiti forest cover of 2% in 2008</i>	<i>Dominican Republic forest cover of 37% in 2008</i>
Criteria for effective community ownership		
<i>Type of externality/ resource</i>	<i>Competition for forests as a source of energy and income</i>	
Institutional design		
Extractive / inclusive	extractive	relatively inclusive
Political stability	weak	stable
Tenure rights security	weak	medium
Checks and balances	weak	stable
Monitoring and enforcement	weak	stable
Policy design		
Investment in measures fostering economic growth	weak	stable
Environmental policy	weak	advanced

Figure 3. Identified decisive institutional design criteria for sustainable resource governance in the context of public ownership of natural resources.

Overall, this report demonstrates that the use of methodologies of institutional economics can look beyond the often generalised assumptions on different ownership models and analyse the details of institutional design that make the critical difference for sustainable resource governance.

No ownership model – private, community, or public – is universally successful at achieving sustainable and equitable exploitation of natural resources. What seems to be at least as important is the design of the institutions that build on the respective ownership models. Nevertheless, the choice of ownership model is important, not least because each comes with a very different set of challenges and potential unintended consequences. Looking at case studies of ownership structures, it is clear that one size does not fit all. There is no option but to design ownership structures and institutions on a case-specific basis.

Introduction

Natural resources and environmental degradation

Halting and controlling environmental degradation has become a matter of urgency for many governments in the twenty-first century. The Millennium Ecosystem Assessment has shown that in the past 50 years, ecosystems and their services have been exposed to greater pressure than ever before in human history.¹ The healthy functioning of ecosystems and their services underpins the very possibility of human life and, in particular, is central for food security, poverty eradication, productive employment, and social stability. For this reason, understanding the means by which natural assets can be protected and sustained is a critical task.

Natural resources, such as fisheries or forests, are either part of or in themselves constitute an ecosystem, and they provide ecosystem services to humans. The degradation of natural resources often occurs in settings of unclear ownership regimes and empirical evidence shows that the total absence of ownership regimes can lead to sustainable resource governance only under very specific circumstances.² Most scholars recognise the crucial importance of ownership for sustainable resource governance.^{3,4,5,6,7}

Ownership models

A central challenge for sustainable development is to create governance structures (i.e. rules and conventions that dictate how a resource can be used) for open access goods that ensure that resources are not degraded beyond a critical threshold. The motivating question for this report is: which ownership models are most conducive to sustainable management of these resources?

This question has raised a number of controversies, not least because ownership is an emotive issue: different ownership concepts translate into different models of resource governance and determine power over the resource. It is generally accepted that no single ownership model is suitable in all cases without exception; however, there are clearly discernible academic strands supporting the primacy of certain models. While Smith,⁸ Demsetz,⁹ Fujita and Bonzon,¹⁰ as well as Helson *et al.*¹¹ and Costello¹² defend private ownership for natural resource governance, Olson,¹³ Mutamba,¹⁴ and Ostrom,³ among others, argue for community ownership and Heilbroner,¹⁵ Ehrenfeld,¹⁶ and Bromley¹⁷ as well as Gregersen⁷ defend public ownership of natural resources.

This report concentrates on factors that enable sustainable resource governance. While much has been written on governance of non-renewable resources, such as

oil or minerals and the associated problems¹⁸, this paper concentrates on renewable natural resources. Two forms of degradation of renewable natural resources are the focus of this paper: direct exploitation for consumption (timber or fish) and indirect degradation (such as biodiversity loss or climate change).

Sustainable resource governance is defined in this context as a regime that avoids degrading the respective ecosystem beyond the critical threshold, leading to a collapse of the resource. The critical threshold of degradation is characterised by the replenishment rate, which defines whether in spite of degradation the stock of the resource is able to reproduce itself.³

Methodology

Most notably with her book *Governing the Commons – the Evolution of Institutions for Collective Action*, Elinor Ostrom set a milestone for the analysis in institutional economics.³ With an empirical case study methodology, she has discerned why certain factors of institutional design are crucial to enabling sustainable resource governance and why common pool resource governance is deemed to failure, if certain factors are not respected in the institutional design.

This logic of a comparative analysis of different, but comparable settings is used throughout this report, even though the ownership models go beyond Ostrom's small-scale common-pool resource case studies. Precisely, institutional settings that emerge in the context of the three major ownership models (private, community, and public ownership) are analysed in order to understand which factors are relevant for successful institutional design for the respective ownership model. Whether an institutional setting is successful or not will be measured according to the abovementioned definition of sustainability, namely whether the replenishment rates are respected in a way that the resource can sustain itself over the long term. Social sustainability and equity – even though not explicitly referred to in the definition of success, because the report has a major focus on the environmental outcome – are included in the analysis, under the assumption that an environmentally long-term sustainable outcome requires social stability as well, which is not given if the established order is perceived as unfair and thus unstable by the stakeholders of the resource.

This analysis is undertaken on eleven case studies, where for each ownership model at least two comparable settings (ownership model, scale, resource, type of degradation, etc.) are analysed. Looking at two comparable settings and comparable ownership models, for example two national fisheries systems, relying on individual transferable quota (Denmark and Iceland), allows us in all the case studies to observe two contrasting outcomes – generally one case able to sustain the resource successfully and the other failing to do so. In the analysis we try to understand why there are diverging outcomes in spite of similar starting conditions and a similar ownership model. This analysis allows us to come to first explorative conclusions on which factors of institutional design are crucial for successful sustainable resource governance.

Given that the analysis for the respective ownership models cannot be empirically exhaustive, because this would go beyond the scope of this report, the established factors for successful institutional design are based on literature; some additional

criteria will be set up, based on the case study analysis. However, the identified factors for successful institutional design are a first explorative analysis, rather than a full and exhaustive empirically verified set of criteria.

Just as in Elinor Ostrom's methodology, the major findings are summarised in tables at the end of each section. These summaries intend to provide an overview for discussions and further analysis of the established criteria.

Outlook

Throughout this report it will be argued that, while none of the ownership models is a panacea for sustainable resource governance, for each model there are key elements of institutional* design that are critical for success. With the support of the 11 case studies, the report points out that institutional design eventually determines whether a resource governance model leads to a sustainable outcome or not.

The report starts with an introduction to the tragedy of the commons and the public good theory in order to frame the analysis. The importance of factors of institutional design is then supported by the analysis of 11 case studies. The results are summarised in figures at the end of each section. In conclusion, the implications of the results are discussed.

*In this context, institutions refer to the rules that humans use while interacting with each other and with the resource in question.

1. Why do ownership models for natural resources matter?

Every new enclosure of the commons involves the infringement of somebody's personal liberty. It is the newly proposed infringements that we vigorously oppose; cries of 'rights' and 'freedom'" fill the air. But what does 'freedom' mean? When men mutually agreed to pass laws against robbing, mankind became more free, not less so.⁴

1.1. The tragedy of the 'unmanaged'[†] commons¹⁹

In history, 1968 is remembered as the year in which questioning the establishment around the world gained prominence. Claims for peace, alongside social and environmental concerns entered the agenda. In this context Garrett Hardin published his article 'Tragedy of the Commons' and coined a concept that would later be used to illustrate the potential incompatibility of the guiding liberal paradigm with sustainable resource management.⁴ Hardin illustrated the tragedy of the commons using the example of a piece of pasture land: each herdsman tries to maximise his personal utility by keeping as many animals as possible on the common land. But when all herdsmen act in this way, the total amount of grazing is greater than the pasture can sustain and all herdsmen are worse off. In the language of economics, the 'negative externality' of one herdsman's actions is the cost that he imposes on all other herdsmen by the increased degradation of the pasture land.

This tragedy can also be modelled in game theory as a multiplayer prisoner's dilemma.²⁰ If individuals primarily seek to unilaterally maximise their personal gain without a cooperation mechanism in place, the resulting situation is often not Pareto-efficient (i.e. some party could be made better off without making anyone else worse off). Richmond Campbell has described Hardin's pastureland situation, as the paradox where individual rational strategies lead to collectively irrational outcomes²¹. One could say that Adam Smith's 'invisible hand' fails to achieve a desirable outcome.

[†]To judge from the critical literature, the weightiest mistake in my synthesizing paper was the omission of the modifying adjective "unmanaged." In correcting this omission, one can generalize the practical conclusion in this way: "A 'managed commons' describes either socialism or the privatism of free enterprise. Either one may work; either one may fail: 'The devil is in the details.' But with an unmanaged commons, you can forget about the devil: As overuse of resources reduces carrying capacity, ruin is inevitable." With this modification firmly in place, "The Tragedy of the Commons" is well tailored for further interdisciplinary syntheses.¹⁸

Thus, despite criticism of ecological and economic inaccuracy,^{22,23} and the fact that other scholars including Aristotle, Hobbes and Gordon had already addressed the difficulty of cooperation for limited resources, Hardin's article represented a milestone on the sustainability agenda²⁴. Hardin's paper gave a name to a problem that wasn't labelled before and his article can be interpreted as a relatively early wake-up call against unsustainable ways of using the Earth's resources.²⁵ Hardin concluded that introducing some form of ownership would be necessary for the resource to be governed sustainably.

1.2. The importance of establishing sustainable ownership models

Hardin's tragedy of the commons has become unexpectedly dramatic since the days when he wrote his seminal article. As illustrated in Figure 4, human demand since the 1980s has already exceeded the biosphere's regenerative capacity.

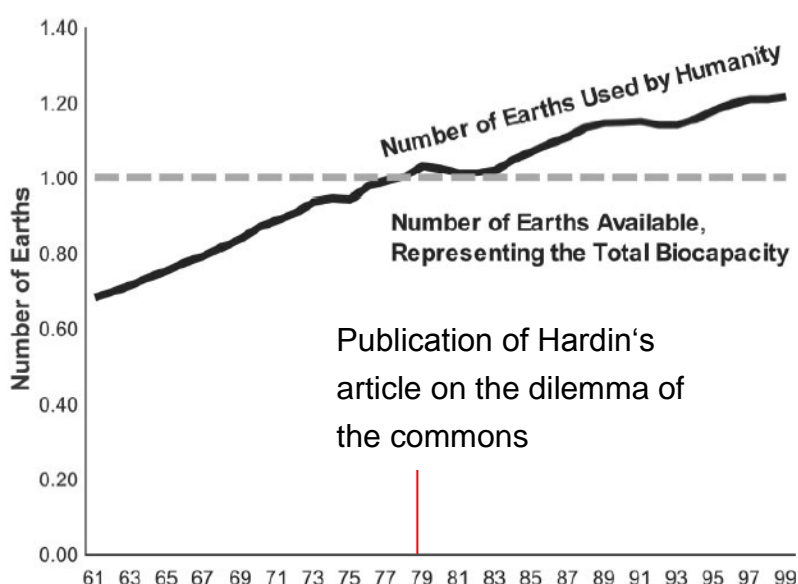


Figure 4. The bio-capacity of the Earth in relation to consumption trends²⁶

Being confronted with this tragedy of the commons and awareness of the biophysical limits of the planet convinced Hardin to advocate birth control in order to limit environmental degradation. In his 'lifeboat ethics' he argued for strict limits to immigration and against foreign aid intervention during the Ethiopian famine, referring to wars and famines as solution to the overpopulation problem.²⁷ He increasingly lost credibility but had framed an issue that would continue to gain prominence on the political agenda: the need to find a solution to environmental degradation, through 'the product of definite social arrangements.'⁵

Despite alarming studies, a growing number of international summits and the increasing popularity of the sustainable development concept, the exploitation of the Earth's resources continues. With emerging economies around the globe striving for Western lifestyles, the problem is taking a more complex shape locally, regionally, nationally, and globally, for both renewable and non-renewable resources. The dream of reducing poverty and inequality through ever increasing growth based on resource intensive economic activities has been contested.²⁸ The challenge is twofold: resources should be distributed equally and consumed sustainably

1.3. Implications of open access ownership models

In order to understand the importance of ownership models in addressing environmental degradation, the following framework is used.

Stocks and flows

To begin with, a useful distinction can be made between a resource system's *stock variable* and *flow variable*. For example, the population of a certain fish species is a stock variable while the growth of that population is a flow variable. This distinction allows identifying the critical threshold characteristic of *common pool resources* or *open access resources* in contrast with *public goods*.³ Identifying stock variables and flow variables allows the definition of the 'replenishment rate': as long as the average rate of extraction does not exceed the average rate of replenishment, renewable resources such as fish stocks can be sustained over time.

Classification of environmental goods

Forests as well as fish stocks (and a whole range of other natural resources) provide what can be perceived as a variety of public and private goods. This report uses the following classification of goods as a theoretical framework: *A good is excludable, when the owners can prevent others from using it. A good is rival, when consuming it, implies that others can consume less of it.*^{29,30,31}

- *Private goods* are divisible, can be sold, and are generally rival and excludable. A private parcel of pasture land is rival and excludable if the owner can build a fence around it without anybody challenging their ownership claim – other herdsmen cannot use the same soil for their cattle.
- *Club goods* are non-rival, but excludable. For instance, the number of users of a telephone network can be increased in an almost unlimited manner, whereas access to the network has to be paid for.

A lot of private and club goods are an output (flow variable) of a stock resource, such as fish sold on the market, which is dependent on the fish stock in the ocean.

Therefore, a wide range of private goods are strongly dependent on the intact functioning of the stock resource.

- *Public goods* in contrast are non-rival because individual consumption of public goods does not reduce their availability for others. Furthermore, public goods are non-excludable, because no one can prevent anybody else from enjoying them. Street-lights or public radio stations are public goods *provided by the state*. Solar radiation, the atmosphere, or the Northern gulfstream – providing Europe with its moderate climate – are public goods *provided by nature*.
- *Impure public goods* are non-excludable, and only rival if they are overused. The police or a public hospital can potentially provide their services to every citizen, but cannot do so at exactly the same point in time.
- *Open access resources (res nullius)* are also goods that are non-excludable and rival. They are accessible to all, but available only to a limited extent.

A new understanding of exhaustible natural resources

Marine fish stocks, tropical forests, and the atmosphere have historically been treated as *public goods* provided by nature, but excessive extraction or degradation has shifted awareness to the fact that they should rather be perceived as *open access goods*. In other words, they were frequently seen as being limitless (the nineteenth-century biologist Thomas Huxley famously asserted that ‘all the great sea fisheries ... are inexhaustible’³²), a misconception that has been revealed due to industrial production methods.

Open access, or common pool resources, is the category of goods that is most relevant to this analysis because most uncontrolled environmental degradation occurs in this context. The important difference between open access goods and other goods is the absence of a defined governance structure.

Figure 5 conceptualises different types of goods. The grey arrow shows how goods that were formerly perceived as public goods are now perceived as open-access resources. The red arrows illustrate how the stock of a resource is necessary for the provision of private goods.

Two major conclusions are relevant:

1. Natural resources that seem to be *public goods a priori* should be characterised and treated as *open access goods*, if they can be degraded beyond a critical threshold (a ‘tipping point’). Scarcity of natural resources that

used to be abundant leads to situations where governance models are required that formerly seemed unnecessary.

2. The integrity of a natural resource stock (in most cases public or open access goods) is a necessary precondition for the provision of a wide range of renewable private and club goods. The damage to the stock resource (the fish stock) has severe implications for the availability of private goods (fish sold on markets) or club goods (recreational fishing). In the following section, the three major ownership models are analysed in order to identify the key elements of institutional design for successful sustainable resource governance.

	RIVAL	NON-RIVAL
EXCLUDABLE	Private Goods	Club Goods
NON-EXCLUDABLE	Open-Access Goods and Impure Public Goods	Public Goods (provided by nature or the state)

Figure 5. Categorising goods in order to explain their implications³³

2. Private ownership of natural resources

The Coase theorem

The Nobel Prize laureate Ronald Coase concentrated much of his work on how societies can deal with externalities in the most economically efficient way. Coase argued that in order to solve the problem, one has to move beyond the conventional understanding that an externality that can only be countered by government regulation. In contrast to classical regulation (taxation, subsidies) he suggests that, in certain circumstances, a more Pareto-efficient solution would be for individuals – those causing the harm and those being affected by the harm – to come together and negotiate privately.

Coase considers the following conditions as necessary requirements in order to enter into a socially beneficial bargaining process:

1. Well defined, divisible and enforceable property rights (i.e. ownership).
2. Low or zero transaction costs for the bargaining process (including full information and non-strategic bargaining behaviour between parties).

The first condition – clearly defined property rights – is necessary because this forms a concrete basis around which negotiations can take place. A clear property right should unambiguously assign the exclusive right to use the resource (or some part of it) and therefore determine which party must compensate the other for that use. Emitting CO₂, degrading pastureland on communally owned land, playing loud music at 3am – all are cases in which the ownership situation is initially often not clear. Conflicts arise because both parties to the conflict consider themselves as having the right to the resource. Who has the right to tell the herdsman who puts an additional animal on the pasture land that he does not have the right to do so? Identifying these rights is a crucial lesson in Coase's analysis.

Coase's analysis argues that in situations of defined property rights over a resource (and zero transaction costs), bargaining between the parties involved will lead to an overall welfare increase. Returning to Hardin's pasture land example, suppose that it has been decided that some of the herdsmen have a historical right to the pasture land. In this well-defined bargaining environment, new entrants can negotiate their access to the pasture land. They can offer the right-holder monetary compensation for not using his parcel of pasture land, or for using a little less of it. In such a situation, it is argued, welfare is maximised since the holders of property rights will only accept compensation if it is greater than the cost of degradation to the pasture

and new entrants will only offer compensation that is less than or equal to the benefits they expect to receive from grazing. Equivalently, since any exchange must be voluntary both parties must benefit from it.

Secondly, Coase argues that government regulation should not be the automatic response to externalities. There is the possibility that private markets can reach an efficient outcome if there are no transaction costs and full information between parties. He argues that direct agreements between stakeholders are a more economically efficient solution because stakeholders can avoid the involvement of public institutions and save the associated information-gathering costs.

Put simply, Coase's conclusion is that stakeholders are best at evaluating the cost of an externality and will be able to negotiate an adequate, Pareto-optimal compensation. This logic is frequently cited as the rationale for 'enclosing the commons' (i.e. privatising communally owned resources) and has found a variety of supporters in the past.^{34,35,36,37} However, it is important to note that the absence of transaction costs is a very restrictive condition and that Coase does not argue against government regulation in general, because there are many instances in which government regulation is more appropriate.

2.1. Case 1: Wolf reintroduction in Yellowstone National Park, USA

In 1926, the last native reported wolf in the Yellowstone National Park was killed.³⁸ While wolves were perceived as a threat and danger by humans, the absence of the predators had a huge impact on the ecosystem in the park.³⁹ Especially, the elk population increased significantly, which caused severe damage to the parks flora, due to overgrazing and cause soil erosion. This had negative impacts on other species. At the same time, in the absence of the wolves the coyote population (formerly prey to the wolves) increased dramatically, which put other species (such as deer and foxes) under threat. In view of their important role for the balance of the ecosystem, biologists concluded that the reintroduction of wolves to the park would be necessary to restore the ecosystem.^{40,41,42}

In 1995, 14 grey wolves that were reintroduced to the park survived and thus a small population was re-established. The reintroduction was a success in the sense that it had a significant positive impact on the park's ecosystem. The elk population was reduced, so that aspen and willow trees could re-establish, which attracted beavers, which in turn are positive for freshwater species. Furthermore, the population of red foxes was re-established.³²

Yet at the same time, surrounding livestock farmers were becoming very worried about the project.²⁷ Although predation of domestic animals represents only a small

share of wolf predations, it was still significant enough for them to fear severe economic losses due to livestock losses, and that they would have to bear the costs of the negative externalities of the conservation project.

This potential negative externality appeared in an unclear context. Had the farmers the right to safety for their animals or should the conservationist's interest in preserving the ecosystem be prioritised over the interest of the farmers? In other words: Which party should be allocated the property rights for use of the resource?

The case was dealt with in a Coasian sense: A local conservation NGO assumed that the farmers had the 'right' to the integrity of their cattle on their land. Having decided upon this initial allocation of rights, the NGO, Defenders of Wildlife, entered into a bargaining process with the local farmers.²⁷ The potential for damage was assessed. Afterwards, Defenders of Wildlife started a campaign, raised private money, and created a trust fund in order to compensate local farmers for potential damages. So the conservation NGO internalised the externality of predation on livestock by compensating for the loss that was incurred by farmers.

Whenever an incident of predation occurs, a trained expert goes to the location and assesses the damage and tries to identify whether it is attributable to a wolf. If it can be confirmed that the damage was caused by the wolf a report is sent to Defenders of Wildlife and within two weeks they compensate the rancher for the damage.⁴³ This procedure still creates transaction costs, but they are low enough so that it is still beneficial for all participants to enter into the bargaining process.⁴⁴

In 2009, the wolf populations had recovered sufficiently in order to meet the goals of the Wolf Recovery Plan, so in May 2008 the US Fish and Wildlife Service changed the status of the grey wolves from Endangered to Experimental Population, Non Essential.⁴⁵ Consequently, farmers were allowed to hunt wolves outside the park into Idaho and Montana, because wolves were believed to be at sustainable population levels inside the park then.^{46,47} Defenders of Wildlife first opposed the change of status of the wolves, but could not put their view through. In 2010 the compensation fund was closed and eventually the government established a federal programme, but not targeting specifically the surrounding farmers of the Yellowstone National Park anymore.⁴⁸

Coasians argue in terms of utility: If people donate to private conservation NGOs valuing the protection of the species they gain utility from paying the farmers and the rancher is compensated with a sum that makes him indifferent to money or his animal. So to summarise in terms of Coase's conditions. (1) Property rights were established: The right to the integrity of their cattle was granted to the farmers. So the NGO compensated farmers for the negative externality that conservation was

imposing on them. (2) Transaction costs, notably the costs of the inspections, were existent, but due to its decentralised and direct nature, low enough for the contract to exist and therefore still a more efficient solution than an external top-down regulation.²⁷ Finally, due to the direct bargaining process and the neutral inspections, relatively full information was provided to both parties.

Importantly, since these property rights are not enshrined in formalised law and are merely an informal agreement between farmers and the NGO, there was a risk associated with how long conservationists would be able or willing to compensate predation with the wolf population re-establishing and thus causing more damage. Even though in this particular case, throughout the period where wolves in the Yellowstone Park were considered endangered, the payments were made. However, this was a limited period of time and had the payments had to go on beyond 2009, with an increasing wolf population, the sustainability of this solution would have been questionable. Yet, given that payments ceased after the environmental goal was reached, the mechanism was quite effective in securing both interests in the critical period of securing the wolf population above its tipping point.

The presumption that farmers owned the right to have their livestock occupy an area at risk of predation without incurring the costs of that predation resulted in a situation in which conservationists made payments to farmers. Had the presumption been that such a right did not exist, these costs would have been incurred by the farmers themselves. This illustrates the importance of property rights allocation for the distribution of costs.

2.2. Case 2: The Oak Ridges Moraine Land Trust, Canada

Oak Ridges Moraine is a 160-km long ridge in Ontario. The area provides a variety of ecosystem services, such as water supply for 250 000 people living in the area, a considerable amount of fishing locations, and a wide range of threatened endemic species. In view of the value of land and the high level of demographic pressure in the region, local conservation NGOs have pushed the federal government to place the area under protection.

The government had other political priorities. After the elections in 1995 the Mike Harris Ontario government had set an economically liberal agenda, including more relaxed environmental regulations and a decrease in funding for the Ministry of the Environment and the Conservation Authority.⁴⁹ Tensions were rising, with the government increasingly ceding the land to private construction projects. Again both parties (conservationists and the political authority) initially had conflicting interests.

In this case, government policy allowed the loss of natural habitat, which has numerous negative externalities in terms of its impact on ecosystem services. The claim to have additional incomes through the expansion of construction areas and to focus on other political priorities was opposed by the claim to protect the habitat.

In view of the degradation and increasingly negative publicity against the government, the government proposed to give the area protected status (Oak Ridges Moraine Conservation Act 2001) and to provide some financial support, if private conservation NGOs agreed to take over the management of the area and provide further funding.

An alliance of conservation agencies organised together in the Oak Ridges Moraine Foundation and developed a governance structure for the park in cooperation with local authorities. Given that the initial capital was not sufficient to sustain the activities, they raised more money through private channels, and received land donations from local residents.⁵⁰

In this context government had the right to decide over the use of the land; that is, the government had a clearly defined property right to the land. At the same time, the conservation NGOs valued the protected habitat sufficiently highly to pay for those services. The NGO established the institutional structures for the protection of the area and thus the provision of a public good. So the government benefits, through improved public perception of its environmental policy when enacting the Oak Ridges Moraine Conservation Act 2001, while it doesn't have to invest the lion's share into the project. The conservation NGOs got the protected area they hoped for and thus had an increase in utility, because the NGOs were already willing to pay for the conservation from the beginning. The allocation of the property rights (to the government) determined which party was required to pay for their use of the resource (the NGOs). Again, transaction costs are low, because the bargaining process could take place directly between a relatively small number of major stakeholders.

However, Logan and Wekerle point out that the privatisation of the management of the park drastically reduces public scrutiny.⁴³ They also point out that the management's level of transparency and accountability is low and that due to this obscurity, there is no guarantee that the areas would remain under a protected status in the long run, or that they would not eventually be attributed to different forms of usage.⁴³ Furthermore, private conservation includes privatised decision-making. Therefore, if the management has a priority for a particular species, it could very well orient its conservation effort towards that species, without taking into account what would be scientifically beneficial for the ecosystem as a whole.

This case also illustrates the crucial importance of the initial distribution of rights and raises the question of responsibilities: Why should the government have the right to increase its income, through more profitable projects, while the conservation NGOs have to take the responsibility to protect a common good? Should it not be the other way round? Should not the government's rights be restricted by its responsibilities to protect common goods? Should it not be in this context that the government is the entity to ensure the long-term protection of the resource, because every other entity is at risk to be distracted by short-term interests, while the public scrutiny could prevent the government from acting inconsistently over time?

Even though the potential of the privatisation of environmental governance and the importance of the involvement of different – including private – actors should not be underestimated, the case points at a risk of a lack of public scrutiny and accountability in private conservation initiatives.

2.3. Case 3: Individual transferable quota system, Denmark

After having experimented with a lot of different models in order to reduce overfishing, the Danish government introduced individual transferable quotas (ITQs) for herring in 2003 and shortly afterwards for mackerel. Based on the success of these programmes, Denmark extended the programme over the entire fisheries system in 2007. Introducing the ITQ system furthermore had the objective to reduce overcapacity and to create economic growth in the sector.⁵¹

In this case, the government retains ownership of the resource *stock* (the population of fish), while the resource *flow* (the harvest) becomes a privately owned property right. Quotas are allocated based on historical landings, while specific rules apply for communities and new entrants. Shares have no expiry date but can be revoked after eight years. Shares are transferable, but there are limits to monopolisation of shares and shareholders must remain active in the sector for at least three years. The whole system is limited by a cap on catches (TACs – total allowable catches). For new entrants to the market a fish fund was established. The fund set aside shares for new entrants into the fishery who were willing to make an investment. As Bonzon observes, the system has also proven to be economically viable for communities.⁵²

The Directorate of Fisheries (Ministry of Food, Agriculture and Fisheries) has the central authority over monitoring and enforcement of the quotas. In cooperation with the European Union it respects compliance with scientifically optimal levels for the maximum extraction.⁵³ Thus, expenditures for the government compared to pre-ITQ system levels have increased due to monitoring and enforcement.⁴⁶

However, the practical implementation of the monitoring system is delegated on a decentralised level to fish-pools. The fish-pool is a privately established cooperative.⁴⁵ The pools are managed by pool-masters that have to be approved and registered by the Danish Directorate of Fisheries. The pool is collectively responsible for catches not exceeding the allowable share. Fish-pools can use an online system to conduct trading of fish shares (<http://www.puljefiskeri.dk>). All share allocations are published on the Danish Directorate of Fisheries webpage. The government invests in fish-tracing technology and other means to allow full documentation of total catches through sensor monitoring and cameras installed on registered boats; in this way the illegal practice of discards (throwing undersize fish back into the water, once they have already been pulled to the surface and are dead) can be avoided. Through the limited availability of allowances, the extraction rates decreased by 30.8 per cent between 2000 and 2008.⁵⁴

Having a more secure basis for catches, fishermen then invested in value-adding activities (such as the processing of fish) instead of concentrating their efforts on the 'race for fish'. Consequently, the landing value of the catches increased while the number of active vessels decreased.

The creation of a system of private rights to the flow of this natural resource has been associated with a movement towards more sustainable exploitation; however, it is not clear whether this is due to the ownership structure or the greater requirement for monitoring. In terms of distributional impacts, the greatest beneficiaries are those that received quota allocations free of charge. On the other hand, considerations of equity have clearly played a part in the institutional design since an allocation of quota is set aside for new entrants (who would otherwise have to purchase the right to fish).

	2005	2006	2007	2008	2009
Number of registered vessels ¹	3 265	3 134	2 957	2 890	2 834
Number of commercially active vessels ¹	1 179	1 093	846	777	703
Number of employed	2 667	2 341	1 751	1 577	1 446
Total landing value (DKK million)	2 902	3 183	2 719	2 560	2 218
Average per commercially active vessel					2
Landing value (DKK 1 000)	2 395	2 785	3 053	3 076	2 955
Earning (DKK 1 000)	1 399	1 726	1 857	1 691	1 696
Operating profit (DKK 1 000)	384	620	829	609	695
Net profit (% of insurance value)	9%	15%	20%	20%	14%

1. A vessel is considered active if it has an annual catch value of more than DKK 245 875 (2009).

2. Preliminary estimate.

Figure 6. Economic performance of the Danish fishing fleet, 2005-09 ⁵⁵.

2.4. Case 4: Individual transferable quotas, Iceland

After various fish stock management tools had failed to prevent the decline of Iceland's fish stocks, the government implemented the first temporary individual transferable quota system in 1983. It was put into place allocating individual allowances on an annual basis. In the initial phase of the programme the transferability of permits was relatively limited and only allowed if the transferring vessel was permanently removed afterwards. Quotas had to be approved by the Ministry of Fisheries. The system was formalised in 1990 through the Fisheries Management Act. In this process the quotas were permanently allocated to current permit-holding boat owners at no cost. The quotas were made fully transferable and divisible among registered fishermen.⁵⁶ The Ministry of Fisheries allocates the total allowable catch annually based on the Icelandic Maritime Research Institute's advice.

Globally this kind of system managed to pull the fisheries industry out of its quick economic decline in the 1980s and managed to prevent several fish stocks from total collapse.⁵⁷ Yet, when looking in more in detail at the performance of the system, and in contrast with the previous case study, it has actually not prevented the cod population from declining, with historical lows in 1993.⁴⁶ Catches have surpassed the total allowable catch threshold by 12% annually between 1984 and 1996.⁵⁸ This makes clear that it is not the type of ownership, necessarily, that determines the sustainability of exploitation; in this case sustainability can be undermined by the political decisions to allocate an unsustainable amount of quota.

Another severe criticism of the Icelandic system has been that during a very long period, factory trawlers and industrialised vessels held the majority of the ITQs. The largest trawler held 56.6 per cent of (cod) quotas in 1998.⁴⁸ Consequently, the government limited the total amount of quotas that one boat owner could hold to 10 per cent.

The strongest criticism concerned quota allocation: given that for a large part of the rural population, fishing is a vital source of income, there is a high level of sensitivity to these allocations. Quotas were initially allocated on the basis of average catches during the three preceding years, instead of being auctioned or sold off.⁴⁹ This distribution was perceived as unfair most of all among small communities, because they automatically had a strongly restricted access to quotas. Communities of fewer than 500 people in particular lost out in the deal.⁵⁰ This highlights the potential trade-off when establishing a regime of private ownership between negative distributional consequences and restrictions on the quality of the private property right.

2.5. Observations on private ownership

As the analysis in Section 2 has shown, private ownership can be a solution to environmental degradation, if certain conditions are met; however, the question of distribution is key.

Privatisation can reduce public sector costs related to enforcement and monitoring because private actors can take the role of environmental stewards and organise these services themselves. Furthermore, it allows the attribution of responsibility for the product to a stakeholder. Yet there is a risk associated with the privatisation of formerly common goods: when privatisation is absolute, meaning that all former stakeholders are totally excluded from accessing the good, there needs to be a high level of accountability and transparency in order to guarantee that the initial objective of sustainable management is respected over time. Public private models, allowing private stewardship but public scrutiny, such as the conservation easements that have gained popularity in the USA, are potential solutions to this problem.

Furthermore, Coase argues that bargaining processes in the context of well-defined property rights lead to efficient outcomes and that it does not matter to whom the property rights are assigned – an efficient outcome will prevail so long as the conditions are met. However, Coase has been criticised for neglecting the question of distribution, which is central to a definition of property rights.⁵⁹ This is a crucial point: the allocation of property rights may not affect the efficiency of the outcome (nor its sustainability) when certain conditions prevail, but it *does* determine the distribution of costs. For example, after defining a private ownership regime, a polluter of the commons *without* property rights may be required to reduce polluting activities without compensation, whereas a polluter *with* property rights must be compensated for the same reduction. Thus, with regard to the social equity of the outcome, which party receives property rights is a crucial decision.

The last two case studies most notably illustrate that the application of Coase's theorem may only achieve a desirable outcome if the implications for distribution (i.e. who must bear the costs) have been properly considered and designed into the ownership regime. Equally, sustainability depends on the ability of the ownership regime to enforce limits on the total level of exploitation. This can be a very challenging task for a resource as intangible as fish. If an absolute upper limit of total allowable catches or a total amount of CO₂ that can be emitted by a country are not defined and respected, the tragedy of the commons will not disappear.

A major caveat of Coase's theory is that it assumes all stakeholders have enough money to make their interests count. The social optimum is at risk if small-scale stakeholders can be crowded out because they do not have the capital to trade and

buy the rights to the resources. In other words, *willingness* to pay depends on *ability* to pay. If the initial allocation of rights is not carefully considered and market forces are relied upon to reach an optimum outcome, there is a high risk that negative distributional impacts will occur. This shows that for the central task of initial right allocation, a public institution, whose authority is accepted and respected by all stakeholders, is necessary. This institution will also be necessary to monitor and enforce the rights that have been allocated.

Inspired by Elinor Ostrom’s methodology,³ Figure 7 summarises the factors of institutional design, which have been shown to have made the crucial difference for successful sustainable resource governance in the four case studies analysed above. The first three criteria (in light grey) refer to Coase’s conditions for successful privatisation in the context of environmental externalities. The subsequent criteria summarise the major factors that could be identified in the course of the explorative analysis. This list is certainly not exhaustive, yet it provides a starting point for further in-depth empirical analysis of factors for successful institutional design, when environmental goods are privatised.

<i>Case study</i>	<i>Wolf reintroduction, Yellowstone Park, USA</i>	<i>Oak Ridges Moraine, Canada</i>	<i>Individual Transferable Quota System, Denmark</i>	<i>Individual Transferable Quota System, Iceland</i>
<i>Criteria for effective private ownership</i>				
<i>Type of externality/ resource</i>	<i>Conservation versus damage to cattle</i>	<i>Conservation versus preferred investment in other policy areas</i>	<i>Fish stock stability versus income from fishing</i>	
The resource was understood properly and property rights could be clarified	yes	no	yes	no
Low transaction costs are associated to the bargaining process of identifying private rights and obligations	relatively low	yes	no	yes
Bargaining process allows a Pareto efficient outcome	yes	yes	yes	yes
In spite of privatisation of rights or costs, transparency and accountability are guaranteed	yes	no	yes	yes
A mechanism to guarantee and enforce long-term sustainability of resource use is available	no	no	yes	no
Compliance with scientific optimum is guaranteed and readjustments to the scientific optimum is possible	yes	no	yes	no
Social justice and inclusion of all relevant stakeholders is guaranteed	yes	no	yes	no

Figure 7. Identified decisive institutional design criteria for sustainable resource governance in the context of private ownership of natural resources

3. Community ownership of natural resources

Seeking solutions to the tragedy of the commons in the middle of the Cold War, Hardin only saw a dichotomy of solutions to the dilemma: a strong regulatory central state or privatisation of the natural resource governance.⁴ He argued that change would have to be instituted with *whatever force may be required to make the change stick*.¹⁸

Elinor Ostrom's contribution

Ostrom, analysing community management of resources, shows that the way the tragedy of the commons has often been modelled – in the form of a repeated prisoner's dilemma – supposes that communication between the players is impossible.³ She argues that not all users of the resource behave in reality as in Hardin's model. *As such, it has been assumed that the individuals have been caught in a grim trap. The resulting policy prescriptions have an equally grim character. [...] I argue that the capacity of individuals to extricate themselves from various types of dilemma situations varies from situation to situation.*³ She presumes that individuals try to solve problems as effectively as they can, in spite of their limited capacity to reason and to understand the structure of complex environments. Her objective is to understand which elements hinder a group of individuals in successfully solving common resource governance problems.

In her analysis, Ostrom attributes the long-term effectiveness of common-pool resource governance through local institutions to eight features of institutional design:

1. Clearly defined boundaries
2. Congruence between appropriation and provision rules and local conditions
3. Collective choice arrangements
4. Monitoring
5. Graduated sanctions in case of non-compliance
6. Conflict resolution mechanisms
7. External recognition of the right to organise
8. Nested enterprise (taking into account different levels of relevant decision-making)

Ostrom developed these criteria after analysing the emergence of common-pool resource governance schemes in a variety of case studies. It has to be kept in mind that the number of stakeholders in her analysis do not exceed 15 000 people.³

3.1. Case 1: Traditional resource governance in Törbel, Switzerland

One of the textbook examples for sustainable collective management is Netting's study of the Swiss mountain community Törbel. Netting has shown how the mountain community has survived for centuries in an environment where natural resources (most notably pasture land, timber, and waste lands) were scarce.⁶⁰ When Elinor Ostrom analysed the case in 1990, she argued that the survival of the community and maintenance of the natural resource were due to a set of well-developed collective institutions.

People from Törbel had a long history of living in this very particular environment and thus the institutions securing its sustainable maintenance had steadily evolved over time. The mountain community was small, constituting about 600 people in 1981. Their socio-economic characteristics had been relatively homogeneous over a long period of history: most of them were small-scale farmers living from cattle ranching on the surrounding pasture lands. The tradition of Törbel's collective institutions dates back to 1224, where Netting could prove first evidence of written collective arrangements and rules on the use of the forests, pasture lands, and waste lands. In 1483, a law banned foreigners from acquiring property on communal land. So Ostrom's first criterion was met, by definitive boundaries for the communal land that were established in 1507, while the law also defined that harvest from specific areas (like gardens) was private. A relatively complex set of rules for the use of the pasture land was developed, allowing each member of the community to let a specific number of cows graze on the common pasture land. So Ostrom's second criterion 'congruence between appropriation and provision rules and local conditions' was met, too. At the heart of the communal institution are the village statutes, which was the main legal institution for the alp association. This corresponds to Ostrom's third criterion: collective choice arrangements. A local authority ensured that no one cheated the community; it counted the cows at the exit gate of the village and imposed sanctions on villagers if they tried to cheat. Another official also marked trees that could be cut down and assigned them to families. This corresponds to Ostrom's fourth and fifth criteria of the need for effective monitoring and graduate sanctions for functioning community governance schemes. In annual meetings, rules and policies were discussed and officials elected. The collective institutions also provided conflict resolution mechanisms, corresponding to Ostrom's sixth criterion. Furthermore, through the collective institutions and the legal and thus externally

recognised right to organise, Törbel complied also with the seventh and eighth criteria of Ostrom's list. This system remained stable despite strong population growth in the nineteenth century and a relative population decline through the twentieth century. Throughout several centuries families had a high level of dependence on the intact functioning of their local resource system and exercised careful stewardship of their resources since they expected their grandchildren to continue to use them. The resource management system that resulted from a collective ownership model actually did increase the quality of the stock resources that the community was dependent on and led to better harvests. Ostrom used the mountain village as an illustration of her principles for effective models that allow governing the commons. Both sustainability and equitable distribution were achieved under this community ownership regime that was possible due to the specific circumstances of the resource, notably its small number of homogenous users.

3.2. Case 2: Modern resource governance in Törbel, Switzerland

Over the last 30 years the situation in Törbel has changed significantly.^{61,62} Although the communal institutions that had evolved over a long period of time still exist, they are losing relevance because the socio-economic framework conditions have changed.

First of all, Törbel has been subject to a huge wave of emigration in the context of increasing urbanisation. Employment opportunities other than agriculture seemed more attractive to younger generations. Furthermore, being an ideal skiing region, Törbel has seen a dramatic increase of winter tourism over the last 20 years. The initial socio-economic homogeneity of stakeholders does not exist anymore, and the common interest in sustainable resource governance has been eroded by a new group of stakeholders and a new source of economic income with rather seasonal interests in the integrity of the resource system. So Ostrom's second and third criteria (congruence of rules and collective choice arenas) no longer apply to the Törbel case in the way they were still valid in the 1970s.

Netting acknowledged later that various outside inputs and interdependencies had in fact sustained the Törbel system and that it was thus not exclusively attributable to the design of its collective institutions. Glasenapp and Thornton conclude: *Netting's early characterization of Törbel as the island in the sky a community having reached a final stasis frozen in time and space is untenable.*⁶³

Over a relatively long period of time Törbel's common pool resource institutions were able to govern the resource in a sustainable manner. But the institutions were designed for a form of use that no longer reflected the socio-economic reality of Törbel. Instead of being totally dependent on the resource, people have found other

sources of income and thus the resource and its governing institutions have lost their importance. This also questioned the economic viability of the collective institutions. At the same time, the changing set of stakeholders made monitoring and compliance with local norms difficult. So Ostrom's fourth criterion no longer fully applied. Basing the sustainable management of natural resources on inherent community structures and social institutions can be successful, especially in contexts which are relatively stable.

This allows drawing three additional conclusions for this specific case on the institutional requirements of common pool institutions: First of all, beyond the design features that make institutions capable of sustainable resource management at a given point in time, institutions need to be adaptable to changing socio-economic conditions. As this case shows, if the institutions are not able to adapt they won't achieve their aims indefinitely. Secondly, institutions emerging from community ownership need to reflect the local socio-cultural norms and conditions.

3.3. Case 3: Mar de Lira fisheries community, Spain

Galicia is one of the poorest regions in Spain. In Lira, a coastal village with 1000 inhabitants, the main source of income for villagers is artisanal fishing, next to agriculture and a small sector for services and tourism.

Fisheries are included in the local *cofradía*, a corporation with jurisdictional, legal and decision-making capacity. Communities pay fees to the *cofradía* to finance it. Furthermore, the *cofradía* receives a share of the fish sale (approximately 3 per cent of the value of fish sold in first sale auctions) and subsidies from the European Fishery Funds (EFF) through a fund managed by the local government (Xunta de Galicia).

The fishermen from the relatively poor region were highly dependent on intact fish stocks. Yet in recent years, overfishing and illegal fishing have already drastically reduced the fish stocks. Furthermore, the fishermen were confronted with a relative monopsony of buyers, which gave them very little power to increase the price paid for their catches.

In 2000, given their difficult economic situation, an Internet-based sale-platform for the catches was established in collaboration with the University of Coruña. This allowed the community to overcome information asymmetries and to sell their catches at higher prices, leading to a 30 per cent increase in incomes.⁶⁴ This was a motivating starting point for further collaboration and tighter cooperation of the community with outside actors, such as neighbouring communities.

In 2002, this momentum was suddenly halted by the Prestige oil catastrophe. Sufficient compensation for local fishermen was not available and many suffered a sudden slump in incomes. In the aftermath of the crisis, local fishermen proposed the creation of a marine protected area to fuel the creation of sustainable management tools for fish stocks.

Eventually in 2007 *Os Miñarzos Marine Reserve of Fishing Interest* was created, covering 21 km² of the common fishing area. The multiple-use marine protected area (MPA) included two no-take zones around breeding grounds that allowed fish stock to recover. So corresponding to Ostrom's first and second criteria, clear boundaries and congruent rules to the common resource were established. Through the marine-protected area, a better understanding of the fish stocks and a better assessment of breeding grounds became possible. A study by the Galician Fisheries Authority Council of the Sea showed an increase in the biomass of goose barnacles by 25 per cent a year after the establishment of the MPA.⁶⁵ Collective choice arrangements could be made in the *cofradía*, which also hired a monitoring company. Thanks to these monitoring efforts illegal fishing decreased drastically. Furthermore, a regulation was passed that prohibited dive-fishing and thus gave monitors legal means against poachers. So Ostrom's third, fourth, and fifth criteria – collective choice arenas, monitoring and graduate sanctions – were met. The *cofradía* could also be used for conflict resolution and to make agreements on how much of the resource each member could extract. Thus Ostrom's sixth criterion, the availability of conflict resolution mechanisms was met. The MPA was formally recognised by all other superior levels of Spanish governance and works in compliance with the broader legal framework. Therefore Ostrom's seventh and eighth criteria (formally recognised rights to organise and an external recognition of these rights) were met, too.

In 2009, a different party was elected in the regional elections. In the context of the economic crisis, public budgets have seen drastic cuts in Spain. The surveillance contract was due to expire in 2011 and would have been renewed afterwards. However, due to budget constraints, the local government halved the number of surveillance officers when the new contract started. Since then the effectiveness of the monitoring has drastically decreased while the amount of incoming diving poachers has risen again.⁵⁶

This case highlights the potential for community-based institutions to complement public institutions in the objective of managing an open access resource sustainably and equitably. On the other hand, the vulnerability to decreasing external financial support in order to run the common institutions shows that the ability of the

community to independently supply its institutions can be a crucial factor for long-term functioning of community ownership models.

3.4. Case 4: Bodrum fishery community, Turkey

The management of the fish stocks on the coast of the Aegean Sea sharply contrasts with the situation in Lira, although starting conditions were similar.

In 1983, there were approximately 400 fishermen in the Bodrum fishery operating in small boats (100), trawlers (11), purse seiners (2), and bottom seiners (9).⁶⁶ Until the 1970s, Bodrum had been a site of successful inshore fisheries. In view of this success, and the apparent relative abundance of fish in the area, the national government encouraged small fishermen to invest in bigger vessels that could increase their catches and thus the prosperity of the region. When initially this promise was fulfilled, it attracted even more fishermen to the region. Eventually the growing number of active fishermen led to overfishing and finally the revenue from the fleet as a whole fell below the cost of fishing in the area.⁶⁷ The catches considerably declined in relation to the fishing effort. Thus the larger vessels moved on to catch in other areas, while a boom in tourism attracted further part-time fishermen into the fishery. This shows that the first of Ostrom's criteria, of clearly defined boundaries (here shares of the fish stock), as well as the second criterion of the congruence between appropriation and provision rules and local conditions, were no longer met.

While there was a local fishing cooperative, it unsuccessfully tried to mediate the conflicts among the artisanal fishermen, the new entrants, and the huge vessels. In 1983, the cooperative had disappeared and there was no longer any form of local management of the fish stocks. At the same time, various different interest groups competed for livelihoods from the same fishing ground, whose fish stocks were in constant decline. So the fishery turned into an open-access resource, where no monitoring or sanctions were applied, no collective choice arenas or conflict resolution mechanism existed, and the formal rights to organise were only recognised very weakly. This shows that Ostrom's criteria 3–6 (collective choice arrangements (3), monitoring (4), graduate sanctions in case of non-compliance (5), and conflict resolution mechanisms (6)) were no longer being met. Consequently, also criteria 7 and 8 (external right to organise (7) and the embedment into other levels of relevant decision making (8)), were not met anymore.

Berkes concludes that Bodrum was *a textbook example of rent dissipation in a fishery*.⁶⁸ The example illustrates how the total absence of any form of governance for open-access resources or weak institutions fosters individual profit maximisation and eventually leads to Hardin's tragedy of the commons. Moreover, it highlights the

possibility of community ownership institutions being undermined by centralised government.

3.5. Observations on community ownership models

Comparing similar ownership models for similar open access resources (like pasture land or fisheries) in similar contexts, with totally different outcomes in terms of sustainability, allows drawing some conclusions on key elements for successful common pool resource governance.

Beyond Ostrom's criteria on boundaries, congruent rules, the need for collective choice arenas, and conflict resolution mechanism, as well as monitoring, sanctions and a formally recognised right to organise and the need to intertwine effectively with other levels of decision-making, some further observations can be made. Community ownership models have been seen to be effective at managing the use of natural resources, both in terms of achieving sustainability and equity. However, the conditions under which success has been observed are generally quite restrictive. Most empirical examples involve small communities exploiting a localised resource and where all parties have a common interest in sustaining the resource. Two further observations are pertinent:

First of all, special collective institutional arrangements can work for a certain amount of time, but cease to function effectively if they are not adaptable to changing socio-economic conditions. Most of all, in a globalised world with high levels of migration, the flexibility of institutions to adapt to changing social compositions, and evolving socio-cultural features of a given community play a crucial role.

Secondly, it is important that the collective institutions are created in a way that sustains the financial needs of the institution and provides its services in an independent manner. Equally, the functioning and legitimacy of local community ownership models can easily be undermined by central governments with incongruent objectives. The institution should be protected from central government interference so long as it is successful at producing conditions of exploitation that are considered sustainable and equitable.

Figure 8 summarises the identified factors for successful institutional design for sustainable resource governance, again using Ostrom's comparative institutional economics methodology. Figure 8 illustrates which factors of institutional design have made the decisive difference for the sustainable governance of the common pool resources. Beyond Ostrom's criteria, the adaptability of institutions, the coherence with social and cultural norms, as well as the economic viability of the institutions themselves could be identified in the case study analysis.

<i>Case study</i>	<i>Törbel, Switzerland (in 1976)</i>	<i>Törbel, Switzerland (in 2006)</i>	<i>Mar de Lira, Spain</i>	<i>Bodrum, Turkey</i>
Criteria for effective community ownership				
<i>Type of externality/ resource</i>	<i>Competition for and degradation of pasture land</i>		<i>Direct competition for and degradation of fish stocks</i>	
Clear boundaries	yes	yes	yes	no
Congruent rules	yes	no	yes	no
Collective choice arenas	yes	no	yes	no
Monitoring	yes	weak	yes	no
Graduate sanctions	yes	yes	yes	no
Conflict-resolution mechanism	yes	yes	yes	no
Formally recognised rights to organise	yes	no	yes	weak
Nested unit (taking scale into account)	NR	yes	yes	no
Adaptability of institutions	seemed sufficient	no	weak	no
Institutions reflecting local socio-cultural norms and traditional forms of organisation	yes	no	yes	no
Economic viability	yes	no	no	no

** NR = was not relevant in specific context*

Figure 8. Identified decisive institutional design criteria for sustainable resource governance in the context of community ownership of natural resources.³

4. Public ownership of natural resources

Public ownership of natural resources can imply a variety of different policy models for natural resource governance. For this section, less straightforward and generalised criteria for successful institutional design in the case of public ownership of natural resources can be found in the literature. Nevertheless, two questions are found to be central to the analysis of public ownership models for natural resources:

1. Does the state have the capacity to enforce its rights to govern the resource?
2. How should public ownership institutions be designed in order to foster sustainable and equitable resource governance?

Institutional capacity

The first question refers to the institutional capacity of the state. Fragile states, like the Democratic Republic of the Congo, have limited capacity to enforce the planned usage (or non-usage) of natural resources. Most notably, Acemoglu and Robinson have analysed which endogenous and exogenous factors lead to the emergence of inclusive institutions.⁶⁹ Karsenty and Ongolo have pointed out that the institutional stability of a country determines whether it is likely to enforce sustainable resource governance.⁷⁰ Many valuable and increasingly scarce natural resources are located in countries with limited statehood and therefore their institutional capacity has been subject to increased scrutiny from environmental policymakers.

Policy design

The second question points to the design features of public environmental policy. Different scholars have advocated different policy models. Classic regulations in the form of command and control models,⁷¹ as well as the use of taxes and subsidies,⁷² have shown different levels of effectiveness.

Comparing the diverging outcomes of public forest ownership in Haiti and the Dominican Republic first, will allow pointing out which institutional capacity and policy choices were made the difference in these two case studies. Eventually, the Brazilian forest policy on the Amazon will be sketched briefly to underline the context related complexity of well-design policies for sustainable resource governance.

4.1. Case 1: Public ownership of forests, Haiti

Once a tropical paradise, Haiti is now a case study of a country committing ecological and economic suicide.⁷³

The two countries of Haiti and the Dominican Republic share the same island (Hispaniola), but two completely different regimes of natural resources governance

have emerged. While in the Dominican Republic there is 37 per cent forest cover, in Haiti forest cover is only around 2 per cent.⁷⁴ Fundamentally, these are countries with very similar endowments in terms of natural capital and with relatively similar exposure to natural hazards. However, Klose and Webersik show that the two countries have completely different capacities in terms of sustainable resource governance and delivering value to society.⁷⁵

Similarly striking evidence exists from other realms of public policy performance: The infant mortality rate in Haiti (1970: 14.83 per cent, 2008: 5.436 per cent) is considerably higher than in the Dominican Republic (1970: 8.7 per cent, 2008: 2.721 per cent), the GDP is considerably lower in Haiti (2011: US\$1034.39 per capita) than in Dominican Republic (2011: US\$8650.61 per capita).

In view of this divergence, these two cases will be analysed in more detail in the following part, to shed light on a range of factors for success and failure in sustainable natural resource governance.

Haiti was one of the most valuable French colonies in the eighteenth century.⁷⁶ Already at that time, deforestation rates were high on the island: a lot of boats brought slaves to Haiti and left the island filled with Haitian timber that was brought to Europe.⁷⁷ In 1791, a slave revolt broke out, which lasted until 1804 and Haitians were required to pay 90 million gold francs to France for the lost property. Due to a lack of cash, this was paid out in timber,⁷⁸ so that already by the mid-nineteenth century, Haiti's mid-mountain slopes and low lands were largely stripped of timber.⁶⁸ The achievement of independence did not lead to the emergence of inclusive institutions, but rather to a continuation of the French colonial extractive model, exploiting population under domestic rule. Trapped in the vicious cycle created by extractive institutions, there were insufficient constraints to the power of the post-independence leaders such as Christoph, Dessalines, or Pétion.⁶⁰ Haiti was not attractive as a trading partner or for foreign direct investment for wealthier states. Slave revolts implied a lot of mistrust and a long-lasting bad investment climate.⁷⁹ From the 1920s, deforestation and overall environmental degradation in Haiti had increased, due to population growth and rural poverty.⁸⁰ Haiti was ruled by 'Baby Doc' Duvalier from 1957 to 1971, who did not pursue any form of systematic development strategy, efforts for industrialisation or environmental policy.⁸¹ Consequently, the country had no macroeconomic stability and could not import wood-fuel. In spite of the increasing scarcity of timber on the island, forests were further degraded.⁶⁷

Some external efforts were made to conserve the remaining forest cover, most notably in the 1980s through US-AID in the Agro-forestry Outreach Program, Pwojè

Pyebwa. Through the programme more than 25 million trees were planted. Yet, for each new tree that was planted, an average seven trees were cut as a consequence of the massive demand for charcoal as an energy source.⁸² The degradation of Haitian forests has reached a critical threshold. Under the current model the population will no longer be able to sustain its domestic wood-fuel demand, but at the same time the country cannot afford imports. High rates of deforestation go along with an important biodiversity loss of unique endemic species, even if reforestation projects are undertaken.

Duvalier's departure was followed by a period of political instability, successive failed elections and coup d'états. Between 1986 and 1990, six different heads of state invested in defence, construction, and loss-making public enterprises.⁶⁷ The coup d'état against Bertrand Aristide was followed by a trade embargo from the Organization of American States and an oil embargo in 1993. Afterwards the country swung between autocratic and democratic regimes.

Consequently, Haiti has gone through a long period characterised by non-inclusive institutions, unstable elites, no checks and balances and a very fragile central state.

Finally, a major problem for sustainable forest governance is the protection of individual property rights and the insecurity of land tenure in Haiti. In the international Property Rights Index, Haiti ranks at the bottom (10 out of 100). Even in cases in which individual property rights are organised through social conventions and local arrangements, there is no institutionalised protection for forests. Dolisca *et al*, have shown the more informal the property rights arrangement is, the more likely households are to deforest in Haiti.⁷¹

The case of Haiti shows that for natural resources that are owned publically and administered by the state, sustainable and equitable management of the resource is unlikely when the government has neither the power to monitor or enforce rules of access nor the desire to manage the resource in the public interest.

4.2. Case 2: Public ownership of forests, Dominican Republic

Although Haiti and the Dominican Republic share the same island, their colonial histories evolved rather differently. Christopher Columbus arrived on the island of Hispaniola in 1492. The indigenous Taínos people disappeared relatively quickly from the island. Compared to Haiti there was a significant number of white settlers in the Spanish colony. However, the Caribbean holding was progressively neglected by the Spaniards, after they discovered the gold resources of the Aztecs and Incas in Mexico. Eventually, through the Treaty of Ryswick in 1697, the western part of the island was turned into the French colony which later became Haiti. Towards the end

of the eighteenth century, the Haitian population was already four times as numerous as the population of the Dominican Republic.⁸³ For a number of reasons the Dominican Republic developed differently from Haiti:

- Due to the high number of white immigrants in the Dominican Republic and the fact that it was Spanish speaking instead of Creole, the country maintained good ties with European countries.
- In large parts this population did not have to deal with the consequences of slavery splitting social cohesion and creating mistrust (as in the Haitian case), although strong inequalities between slave descendants and white migrants persisted.
- The Dominican immigrants included many middle-class business people and skilled professionals who contributed to the country's development.⁶⁸
- The cultural proximity remained an important colonial heritage, which also favoured foreign investment into the Dominican Republic rather than into Haiti.

Haiti has seen much more severe degradation of its forests than the Dominican Republic. While in 1920 still 75% of the Dominican Republic's territory was covered with forests, there was only 60 per cent left in Haiti.⁶⁵

Distinctive divergence is observable during the twentieth century. Similar to Haiti, the Dominican Republic was ruled by a dictator from 1930 to 1961, Rafael Trujillo. Yet, in contrast to Duvalier, Trujillo placed a stronger emphasis on industrialisation and economic development of the country.^{67,84} Under Trujillo's rule the Dominican Republic became a net exporter of cigars and sugar cane. The country was able to import wood-fuel substitutes and change its energy provision.

At the same time Trujillo developed environmental policy. In 1934 the first national park was created and was followed by a large range of national conservation areas.⁷² The government also set up a forest warden agency to protect the park system. In the 1950s, Trujillo's regime assessed the potential for hydroelectricity. When the commission concluded that only forested waterways could support hydroelectric dams, Trujillo banned logging in potential river watersheds and slash-and-burn techniques. While logging resumed during the period of political instability following Trujillo's murder, the election of Joaquín Balaguer saw the launch of a military operation against illegal deforestation in 1967.⁶⁸ Throughout the following period the environment received more respectful treatment. Environmental education projects such as *Plan Sierra*, were successful in creating sustainable opportunities for rural farmers.⁸⁵ Eventually in 2000 the General Law on Environmental and Natural Resources, was passed and created the Ministry of Environment and Natural

Resources.⁸⁶ The ministry has been rather successful in monitoring protected areas and enforcing their borders and has earned substantial credibility in the country.⁷²

Although struggles around land rights continue to exist in some rural areas, tenure rights are generally secured and borders are relatively better enforced than in many other Latin American and Caribbean countries. The Dominican Republic ranks relatively high (68 out of 100) on the international property rights index,⁸⁷ the political elites are now democratically elected and checks and balances exist to restrict central monopolies of power. So although the situation in the Dominican Republic is far from ideal, both a higher level of inclusiveness of political institutions, and a stronger commitment to environmental protection by the government have fostered more sustainable forest governance in the country than in Haiti.

That these two case studies derive from the same Caribbean island yet have seen drastically different outcomes in resource management underlines the fact that the nature of institutions is critical for sustainability. Moreover, since both cases adopt the same general form of ownership (i.e. state ownership) it is clear that *quality* of institutions may in some cases be at least as important as *type* of institutions.

4.3. Case 3: Public forests governance, Brazil

While in the 1990s deforestation in the Brazilian Amazon was taking place at an alarmingly high level, it dropped to a historically low level in 2012.⁸⁸ Since 2004, the peak of deforestation, the rate of forest clearing in Brazil has fallen by almost 75 per cent. The major driver of deforestation in the Brazilian Amazon is industrial agriculture (above all cattle ranching and soy bean production).⁸⁹ This is a very different situation from the sub-Saharan African context where governments have to address uncontrollable small-scale deforestation within weak state structures. A policy is easier to monitor and enforce if there are a few key actors, rather than a large number of small-scale actors. For the Brazilian government, addressing these drivers of deforestation was a good opportunity to demonstrate its institutional capacity.

Through the 1980s and 1990s, the dominant paradigm was still that deforestation was necessary for economic development. A lot of policies supported the infrastructural and agricultural development of the region. When deforestation reached a critical level towards the end of the 1990s, a policy response followed.

A variety of policy measures were passed and the target of reducing deforestation was adopted across sectors and policy areas. This translated into improved land-use planning and the expansion of protected areas.⁹⁰ In this context, the government

committed itself to nationalising 50 million hectares of its forest land by 2010, an area comparable to the size of Spain.

At the same time, the legal framework for deforestation was strengthened, along with better law enforcement, penalties, and sanctions on illegal logging. Furthermore, Brazil developed one of the world's most advanced satellite forest monitoring systems. Combined with strengthened on-the-ground-monitoring capacities the country was well equipped to take control of its deforestation.⁹¹

Another substantial achievement was the change in lending policies from the Bank of Brazil: The national development bank changed its credit conditions and ceased to finance investments in agricultural expansion on natural forest lands.⁸²

In 2012, the country passed a revised version of its forest code, which sets a cap on how much forest landowners are allowed to clear. The country has also used payments for ecosystem services and REDD+ (Reducing Emissions from Deforestation and Forest Degradation Programme) in order to provide financial incentives to shift agricultural expansion away from natural forests.

The positive development of deforestation rates was supported by macroeconomic stability and a strong national currency that reduced Brazil's agricultural export competitiveness and thus lowered investment in agricultural expansion.

Nevertheless, scholars agree that the reversed trend in deforestation is attributable to the development of a reliable political framework. In contrast to the case of Haiti, a capable and legitimate state has been able to provide a clear and reliable ownership regime in Brazil. The policy was not only effective; it has also proven economically affordable.

The case shows that a carefully considered combination of policies can lead to sustainable resource governance, even though this temporary success does not mean that deforestation rates do not rise again, if external or internal conditions change (in fact a weakening of the legal protection has led to a rise in deforestation again in 2013).⁹² The challenge for the Brazilian government is thus to adapt the policies to a changing political and economic reality over time. In terms of distributional implications, the nationalisation of forested areas gives the property right of the resource to the public. The government will manage the resource in the public interest, at least in theory, being held accountable through democratic elections. Those who would deplete the resource must bear the cost, either through being unable to access the resource which they had previously benefited from or through having to pay for its use.

4.4. Observations on public management of natural resources

Going back to the initial distinction between two elements that are needed for successful public ownership of natural resources (institutional capacity of the state and policy design), conclusions can also be drawn on two levels.

First of all, the case of the Dominican Republic and Haiti shows that the stability and legitimacy of institutions determines significantly whether a country will be able to deliver sustainable management of its natural resources. Factors were more favourable in the Dominican Republic than in Haiti and two in particular made a decisive difference: (1) the need for environmental policy was recognised early and combined with legal commitment in the Dominican Republic; and (2) the Dominican Republic created inclusive democratic institutions that were able to enforce the environmental governance it had put in place. Figure 9 summarises the fundamental difference in policy choices and institutional design that caused the divergence in terms of sustainable public resource governance between the two countries.

<i>Case study</i>	<i>Haiti forest cover of 2% in 2008</i>	<i>Dominican Republic forest cover of 37% in 2008</i>
<i>Criteria for effective community ownership</i>		
<i>Type of externality/ resource</i>	<i>Competition for forests as a source of energy and income</i>	
<i>Institutional design</i>		
Extractive / inclusive	extractive	relatively inclusive
Political stability	weak	stable
Tenure rights security	weak	medium
Checks and balances	weak	stable
Monitoring and enforcement	weak	stable
<i>Policy design</i>		
Investment in measures fostering economic growth	weak	stable
Environmental policy	weak	advanced

Figure 9. Identified institutional design criteria for sustainable resource governance in the context of public ownership of natural resources.

The second level that is crucial for the success of public ownership models is the design of the respective policy model. The Brazilian case shows that the policy objective of governing resources sustainably, required a fundamental restructuring of the economy.

This case shows that the state has the power to change the rules of the game. If the resource is in public ownership and the state has the capacity to enforce its policy, it

may be the best capable actor to lead stakeholders that are stuck in the tragedy of the commons out of the dilemma, by making changes to the institutional framework. Yet state ownership of resources can create a number of difficulties. States can only imperfectly anticipate individual rationalities and all collateral consequences of policies. Furthermore, there is a cost to society resulting from the need to monitor and enforce public ownership.

In general, public ownership is best suited to resources that have one or more of the following qualities: a large geographical scope, a strong public (or even global) good nature, a large number of heterogeneous exploiters, or an associated ecosystem service that is particularly vital. In theory, a government will manage the resource in the public interests, so that those who would deplete that resource against those public interests must bear the cost of doing so.

Conclusion

The preceding analysis has shown that the establishment of an ownership model is only one step towards sustainable resource governance: no form of ownership can guarantee sustainable resource governance *per se*. Ultimately, the institutions that are developed within the different ownership models may be at least as important as the ownership structure itself. Evidence from 11 different case studies underscores this argument. The analysis points to institutional and policy design features that have led to successful governance of natural resources for each of the ownership models and also points to potential problems that can arise and that should be respected in institutional design.

Private ownership

Privatisation may lead to sustainable and economically efficient outcomes in certain circumstances. However, the resource may become vulnerable to the whims and special interests of the rights holder. Therefore, an institutional framework that limits the potential arbitrariness of the private owner of the resource and their potential preference for immediate total degradation may be necessary. In cases where access to natural resources is limited through regulation and access rights are then allocated to private owners, a central institution is still needed in order to allocate initial rights and to guarantee the protection of those rights. A misallocation of initial rights in conflict with the scientific optimum can have devastating consequences for the sustainability of the resource. Finally, where a socially desirable outcome includes the attainment of an equitable distribution of costs and benefits, careful attention must be paid to the initial allocation of property rights since this determines which parties will ultimately bear the costs. This is particularly important in cases where the *willingness* of certain parties to pay for access to a resource is affected by their constrained *ability* to pay.

Community ownership

In some cases, community ownership models can provide more cost-effective monitoring and enforcement when those who use the resource become the monitors. Community ownership models may experience problems if the actions of central governments undermine their legitimacy, or if the community institutions are unable to change in line with evolving social and economic conditions. Finally, community ownership models can only apply if the size of the institution can exercise effective power over the resource. It is likely to fail as soon as the scale of the resource (e.g. the climate, or the entire ocean) exceeds its institutional capacity.

Public ownership

Public ownership of natural resources is considered an economically inefficient solution by some scholars because central government may be required to invest substantial resources in monitoring and enforcement in a local situation when local exploiters may already possess superior knowledge. However, in cases where the resource has a large geographical scope or has a significant public good quality, central government may be the only party with the capacity to provide monitoring and enforcement services. When governments are invested with the responsibility to provide institutions that enforce sustainable and equitable exploitation but do not have the capacity or legitimacy to fulfil that responsibility, the outcome may be tragic.

Ownership: necessary but not sufficient

Overall, it can be observed that some form of institution that has the authority to set the conditions and the broader framework for governance of a resource has proven to be necessary in every model. Getting the institutional design features for these institutions right is a crucial element for successful sustainable resource governance. Thus, establishing an ownership regime is a necessary but not sufficient condition to assure sustainable resource governance.

However, certain models are more appropriate under particular conditions – for example, a public good resource, such as clean air, is likely to be best managed by a centralised institution, while a small-scale resource with few exploiters may be more amenable to community ownership. The choice of ownership model will also have implications for the ultimate distribution of costs. However, as important as the choice between ownership models is the subsequent design of the rules and institutions that govern exploitation of the resource. In other words, establishing an ownership regime is a necessary but not a sufficient condition to assure a sustainable or equitable outcome.

The case studies in this report have highlighted instances for each of the three major models of ownership for sustainable resource governance, in which depletion and degradation have continued despite an attempt to institute ownership.

In the context of an open access resource, or Hardin's pasture land, no stakeholder will change their individual behaviour if there is no collective change in behaviour. Unless ecologically benign dictatorship is tolerated, collective institutions and arrangements involving all stakeholders are the only authority to set consistent rules for the use of natural resources. It doesn't matter whether these institutions subsequently rely on a strong form of cooperation, or whether they only fulfil the minimal task of ensuring environmental long-term sustainability.

This analysis has identified criteria for successful institutional design for specific cases. In order to properly understand which particular criterion makes a difference for sustainable resource governance, the case study methodology was chosen. However, beyond the scope of this report, it would be valuable to conduct broader empirical research in order to examine whether the identified criteria could be validated beyond the scope of these case studies and to explore general principles for institutional design leading to sustainable resource governance.

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