

# Bundles, Duties, and Rights: A Revised Framework for Analysis of Natural Resource Property Rights Regimes

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**ABSTRACT.** *In their 1992 paper, Schlager and Ostrom presented a property rights framework characterized by nested, cumulative attributes. It has become arguably the most ubiquitous framework for analysis of natural resources and property rights. We revisit their contribution and discuss how the framework could evolve to address increasingly complex situations, with particular attention to institutional change. We devote increased attention to duties and liabilities associated with right allocation, tying the framework to a broader property rights literature. We conclude with an application to reducing emissions from deforestation and forest degradation (REDD+), illustrating how revisions to the framework facilitate contemporary institutional analysis.* (JEL K11, Q15)

## I. INTRODUCTION

Property rights, defined as “a claim to a benefit stream that the state will agree to protect through the assignment of duty to others who may covet, or somehow interfere with, the benefit stream” (Bromley 1991, 2), hold great importance in the study of natural resource management issues. As Kundhlande and Luckert (1998, 1) write, they “are thought to affect the expansion of the market system, production and distribution of output, and affect incentives to efficiently manage resources.” Over the past few decades, property scholars concerned with natural resource management have advanced several typologies suitable for conceptualizing formal property rights that broaden the more traditional classification of property as private, communal, or state owned. Kundhlande and Luckert (1998) categorize property rights on the basis

of 11 individual factors (comprehensiveness, exclusiveness, use designation, duration, allotment type, size, transferability, fees, operational requirements, operational control, and security). Leach, Mearns, and Scoones (1999) focus instead on issues of endowments (the rights and resources in hand) versus entitlements (control over alternative commodities), with property rights being used to allocate the former. Ribot and Peluso (2003), meanwhile, focus on the issue of resource access, or the *ability* to use a given resource.

In their review of the “diverse bundles of rights” held by various users of a given resource system, Schlager and Ostrom (1992, 249) identify five separate bundles: access, withdrawal, management, exclusion, and alienation. They further array these bundles across four classes of user: authorized user, claimant, proprietor, and owner. In doing so, they created a framework generally capable of capturing the diversity of property rights arrangements present in natural resource systems. It has since been applied to assess the role of property rights in determining sustainable outcomes, institutional formation, and institutional dynamics in, for instance, fisheries (e.g., Edwards 1994; Sekhar 2004), forests (e.g., Hayes 2007; Hayes and Persha 2010; Larson, Barry, and Dahal 2010; Roy, Alam, and Gow 2012; Jagger 2014), and irrigation systems (Meinzen-Dick and Bakker 1999).

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Comparative analysis of property rights systems is one area particularly well suited for the Schlager-Ostrom framework. Their 1992 paper features just such a comparative analysis of Maine fisheries. Comparative analyses also feature prominently among the examples cited above. The issue explored here is whether the Schlager-Ostrom framework can be further adapted to better assess the process of institutional change itself. We also turn to the broader property rights literature and discuss how relevant contributions from legal, institutional, and economic scholarship can help inform a revised bundles framework. Placing the Schlager-Ostrom framework in the context of contributions from Honoré, Hohfeld, Bromley, and others, we present an example of what a modified framework could look like, as applied. We conclude with a brief case study making use of our amended property rights framework in the context of reducing emissions from deforestation and forest degradation (REDD+) activities.

## II. THE CONTINUED EVOLUTION OF A DOMINANT ONTOLOGICAL FRAMEWORK

The notion of rights as a separable bundle is a prevalent and long-running theme in the literature. Penner (1996) cites contributions from Hohfeld and Honoré as providing the basis for what he calls the “conventional formulation” of the separable bundle. Other notable contributions include those by Alchian and Demsetz (1972) who discuss a bundle typology in the context of the firm, and Eggertson (1990) who discusses the partitioning of rights across multiple parties, with a focus on the role of the state and the economic outcomes of alternative allocations.

There are many benefits of a nested framework as operationalized by Schlager and Ostrom (1992). A primary advantage is that it aids in the disentanglement of a given property rights regime, thus allowing for detailed examination of both the resource and the users of that resource (Hayes 2007). By arraying rights in a nested and cumulative manner, it is possible to dissect property rights regimes to determine the bundles held by a given individual, to score those relative to a complete

bundle, and to investigate the implications for any absences or changes over time (e.g., Larson, Barry, and Dahal 2010). The cumulative nature provides a way of understanding heterogeneity in property rights between and within individuals and communities of resource users, allowing for differentiation by socioeconomic status, ethnicity, gender, and so forth. It likewise allows for more meaningful exploration of the behavior and causal aspects of property rights endowments (e.g., is property rights regime A associated with higher productivity, higher equity, etc., than regime B?).

Despite its strengths, some have argued that a “bundles” framework, generally, and the Schlager-Ostrom framework, specifically, is an insufficient or inappropriate lens through which to view property rights and natural resource management issues (e.g., Penner 1996; Smith 2011; Bergström 2005). Even if one accepts the relevance and appropriateness of a bundles perspective, a practical concern with the Schlager-Ostrom framework is that the bundles defined therein may not adequately capture the full range of rights and resource conditions of relevance to contemporary natural resource management. Here, we explore how this issue can be rectified.

We begin with the argument that the issue of resource *alteration*, defined as the ability to change the goods and services provided by the resource, is a special case, and one that at present has a difficult time fitting cleanly into the existing Schlager-Ostrom framework. Next, we embark on a review of the broader literature on the subjects of ownership and the obligations associated with the allocation of each rights bundle, including alteration. Although it may not have been a priority given the focus of Schlager-Ostrom’s original work, the framework nonetheless confuses notions of rights and powers, of duties and liabilities and complicates the empirical analysis of complex and changing property rights systems. We attempt to address both issues below.

### Increasing Resolution: The Addition of a Sixth Bundle

Schlager and Ostrom (1992) discuss five bundles of rights: access, withdrawal, man-

TABLE 1

Overview of Revised Rights Bundles as Defined by Schlager and Ostrom (1992, 250–1) and Expanded Upon Here

Right	Description
Access	“The right to enter a defined physical property”
Withdrawal	“The right to obtain the ‘products’ of a resource”
Management	“The right to regulate internal use patterns and transform the resource by making improvements”
Alteration	The right to change the set of goods and services provided by a resource
Exclusion	“The right to determine who will have an access right, and how that right may be transferred”
Alienation	“The right to sell or lease [some] or [all management, alteration,] and [exclusion] rights”

agement, exclusion, and alienation. As we revisit the framework, we ask whether it can be improved upon to better address situations of institutional change. In particular, we ask whether the original five bundles both fully capture and appropriately distinguish between important contextual differences encountered in contemporary natural resource management.

Included in Table 1 are the original five bundles and an additional sixth, *alteration*. We argue that alteration is a necessary distinction in the Schlager-Ostrom framework owing to the unique situation leading up to, and the far-reaching implications resulting from, a change in fundamental resource attributes. We emphasize that alteration is different than management, which involves transformation of the resource by *making improvements*. Examples of management include establishing rules regarding the sustainable harvest of timber, making decisions about the length of time to fallow a parcel of land, or rotating the location of fishing sites to minimize depletion of the resource. Alteration, on the other hand, involves the complete transformation of the resource from its current state in ways that may be positive or negative depending on perspective and the outcome of interest, for example, clearing a forested stand for agriculture, planting trees on marginal pastureland, or impounding a wa-

terway and inundating associated low-lying areas in the name of hydroelectricity generation.

We argue that alteration is fundamentally different from management in that the former involves a change in the flow of goods and services associated with the resource, whereas the latter concerns the internal regulation and transformation within a particular resource. Unless “resource” is defined here to be so broad as to represent all available land uses, *alteration* and *management* are very different concepts with very different implications for rights holders.

If an additional bundle is to be useful in the context of the Schlager-Ostrom framework, it must somehow be set in the context of the other five bundles. But where does alteration fall along the spectrum of various rights put forward some 20 years ago? A strength of the Schlager-Ostrom approach is that it allows for the arraying of different categories of rights, facilitating distinctions to be made among the different types of individuals and groups based solely on the rights they hold. These rights bundles are generally cumulative, meaning that they contain and build upon the preceding bundle.

We place *alteration* between *management* and *exclusion* (Table 2). Schlager and Ostrom (1992, 251) define management rights as conveying the authority to “regulate internal use patterns and transform the resource by making improvements.” Alteration could at first be seen as a more extreme version of management. In terms of effects on rights holders, however, alteration and management are quite different. Management implies operation *within* a given resource system, further suggesting that options for use by those holding other levels of rights (proprietors and owners) may be preserved. Alteration changes the very nature of the resource in question. This argues for alteration to be placed higher in the hierarchy, as fundamental changes in the resource can be seen as removing options from others in the array. For example, changing a given land use from one to another (from forest to agriculture) not only affects the nature of the activities that may take place on that land, but also who may make use of that land and who may make decisions regarding that use. This

TABLE 2  
Matrix of Owner Types and Individual Right Bundles

	Owner	Proprietor	Claimant	Authorized User
Access and withdrawal	X	X	X	X
Management	X	X	X	
Alteration	X	X		
Exclusion	X	X		
Alienation	X			

Source: Adapted from Schlager and Ostrom 1992, 252.

becomes apparent in our application of the revised framework in the context of REDD+, below.

Decisions over alteration may themselves be trumped by higher-order exclusion or alienation collective choice decisions. Without the collective choice rights of exclusion and alienation, alteration is thus best viewed as falling within the purview of a proprietor. But as the above text makes clear, the issue is not straightforward. Alteration is a complex phenomenon and can affect all user types, regardless of where it is placed along Schlager and Ostrom’s hierarchy. It is this complexity that warrants special attention to the issue and explicit discussion of the bundle separate and apart from the others previously identified.

We argue that the fundamental differences between management and alteration necessitate their separation. The addition of bundles should be undertaken with care, however. Experience with the empirical intractability of the original Schlager-Ostrom framework in applied field settings suggests that an even more complex framework may be that much more empirically challenging. As Hohfeld (1913, 16) cautions, “too close an analysis might seem metaphysical rather than useful.” Only in situations in which the existing framework fails to capture and distinguish important differences in institutional or natural resource conditions, such as is argued here, is such refinement appropriate.

**Anchoring to the Broader Literature: A Reference to Duties**

There is a vast legal and institutional literature pertaining to duties, liabilities, and

ownership. There is, however, little reference of this broader literature by Schlager and Ostrom (1992) or vice-versa. Envisioning how the Schlager-Ostrom framework may evolve to better capture situations of institutional change requires an examination of how its fundamental concepts fit into broader scholarly contexts.

It is of course impossible to do justice to the vast literatures of property rights and ownership in the space provided here. What follows is not a literature review per se, but rather a brief discussion of how the framework relates to seminal works of legal and institutional scholarship. The goal of this exercise is not to refute key assertions or to pass judgment on the appropriateness of one approach or another. Rather, we hope to simply draw a more coherent linkage between these oft-separated schools of thought, leveraging what is known in both to the study of contemporary natural resource problems, while simultaneously motivating our suggested revisions to the framework.

Of particular relevance to this discussion are works by Wesley Hohfeld, Tony Honoré, and Daniel Bromley. Spanning nearly a century between them, their collective works have taught us much about ownership, property rights, property relations, and the incentives that are created by different property rights arrangements. Despite relevance to the Schlager-Ostrom framework, few if any works devote significant time to a discussion of the linkages. Works by Bromley are cited within Schlager and Ostrom’s 1992 paper, though these references reflect empirical findings rather than theoretical underpinnings. Others discuss the different works side by side

but do not comment on their relationship (e.g., Veetil, Kjosavik, and Ashok 2013). Works co-authored by Ostrom herself discuss the contributions of Hohfeld and Honoré to the study of property rights but do not link that material back to the bundles framework (e.g., Ostrom and Ostrom 1999; Cole and Ostrom 2010). In particular, Cole and Ostrom (2010) briefly discuss the work of Hohfeld and Honoré and the Schlager-Ostrom framework, even going so far as to comment on the potential for overlap and divergence, but do not elaborate further.

Given the rarity of direct comparison, one could therefore suppose that Schlager and Ostrom (1992) have little to gain or to contribute to these other works. On the other hand, the repeated mention of them alongside one another implies connections. It seems to us that Hohfeld, Honoré, Bromley, and Schlager and Ostrom are not so much in disagreement, as they are talking about different things. At the very least, they emphasize different parts of a related whole. Honoré outlines the elements of full ownership, Schlager and Ostrom focus on the arrangement of individual rights, and Hohfeld and Bromley emphasize the incentives that are transmitted between rights holders. We argue that, to be relevant to changing and increasingly complex natural resource management regimes, the Schlager-Ostrom framework must somehow be placed in the context of these other works. The question, raised by the conspicuous absence of this in the literature, is how?

We begin with Honoré (1961), who sets out to articulate the incidents or elements of full ownership (rights to possess, use, manage, income, capital, security, incident of transmissibility, absence of term, prohibition of harmful use, liability to execution, residuary character). The linkages between Honoré (1961) and Schlager and Ostrom (1992) are several and varied. In introducing the incidents of ownership, Honoré (1961, 113) explicitly mentions a bundles perspective, noting that “it is fashionable to speak of ownership as if it were just a bundle of rights, in which case at least two items in the list would have to be omitted.” Two questions spring from this: (1) which of Honoré’s incidents stand to be omitted, and (2) how could

a Schlager-Ostrom nested bundles framework align with Honoré’s remaining incidents? These two questions are themselves preceded by a more fundamental consideration, whether the Schlager-Ostrom framework could be viewed from the perspective of Honoré’s incidents. Essentially, are they even compatible?

While it is theoretically possible to align incidents with their corresponding bundles, it does not follow that forcing all of one into the other is an appropriate exercise. Honoré and Schlager-Ostrom clearly set out to speak to different situations, with Honoré’s focus on legal systems and Schlager and Ostrom’s emphasis on common property regimes. Honoré’s 11 incidents also provide a great deal more detail than the five bundles of the Schlager-Ostrom framework and speak to the larger institutional context within which rights are allocated. For example, incidents of security, transmissibility, absence of term, liability to execution, and residuary character all pertain to the durability and transfer of rights, aspects that are largely unaddressed in the Schlager-Ostrom framework. Another incident of particular interest is prohibition against harmful use, which could more appropriately be defined as a duty or responsibility and less as a right as elaborated upon by Schlager and Ostrom. A question explored below is whether a greater focus on such duties and responsibilities is an appropriate exercise in the context of the Schlager-Ostrom framework, and whether the inclusion of duties represents an improvement upon the original framework.

Beginning with Hohfeld (1913, 1917), scholars have devoted attention to the relationships between different classifications of legal relations, with rights and duties being of particular relevance. Hohfeld’s work also advanced understanding of right structures and individual relationships. Hohfeld (1917) devotes significant effort to describing the important distinctions between the rights and duties held by individuals against other individuals (in personam) and those held against multiple individuals (in rem). This distinction allowed for further analysis of the relationships between individuals, allowing for clearer articulation of the legal recourse for violation of rights (and claims), and therefore



a more complete and critical evaluation of incentives. We believe this is a particularly salient contribution given the ubiquity of cases that have demonstrated property rights regimes where duties are not upheld.

The subject was furthered by Bromley (1989, 1991), who expanded Hohfeld’s earlier paradigm and Demsetz’s (1967) ownership classification scheme to examine the incentive structures put into place by various property rule arrangements. In his works, Bromley devotes significant time to explaining the differences between rights, duties, and privileges. He likewise describes the “triadic relationship” that rights create between an individual with the right, an object to which the right pertains, and all others who must respect that right, stating that “rights can only exist when there is a social mechanism that gives duties and binds individuals to those duties” (1991, 15). This at once speaks to two issues: the role of enforcement, and the presence of affirmative obligations or duties. Without diminishing the critical role played by enforcement in property rights regimes, the focus at present is the notion of duties in the exercising of rights. As Bromley likewise notes, “rights have no meaning without correlated duties and the management problem with open access regimes is that there are no duties on aspiring users to refrain from use” (1991, 2).

Hohfeld (1913, 9) provides a straightforward definition of duty that serves well the purposes of the present exercise: “that which one ought or ought not to do.” Some property rights typologies treat duties as implicit or explicit characteristics of property rights (e.g., use designation and operational requirement characteristics as defined by Kundhlande and Luckert 1998). For their part, Schlager and Ostrom (1992, 250) note the importance of clearly articulating the difference between rights and rules, specifically that “‘rights’ are the product of ‘rules.’” Citing Commons (1968), they briefly discuss the function of rules as specifying both rights *and* duties.

The question then moves to how duties are treated in the Schlager-Ostrom framework, how this relates to the above works by Hohfeld and Bromley, and how this affects the application of the framework to natural resource management issues, with specific emphasis on

TABLE 3  
Selected Static and Dynamic Correlate Legal Relations

	Alpha	Beta
Static	Right	Duty
Dynamic	Power	Liability

Source: Adapted from Bromley 1989, 1991; Hohfeld 1913, 1917.

institutional change. To narrow the field of analysis, we begin by applying the Schlager-Ostrom framework in the context of the Hohfeldian paradigm of correlated relations, limiting our evaluation to a subset of legal relations identified by Hohfeld and expanded upon by Bromley (1989; 1991). These are listed in Table 3. Static correlates refer to existing or established relationships, whereas dynamic correlates function in situations where new relationships may be created. Below, relations are apportioned to two hypothetical users, Alpha and Beta. In one situation, Alpha has a right, and Beta has the correlated duty to observe that right. The situation could easily be reversed, such that Beta has the right and Alpha is bound to observe the right. Alternatively, we could have a situation in which Alpha has the ability, or power, to develop a new relation with Beta, one that Beta is unable to stop (a liability).

Although both Schlager and Ostrom (1992) and Ostrom and Schlager (1996) describe rules as defining the allowable or required actions that accompany the exercising of a particular right, they devote a vast majority of their work to a discussion of rights. Apart from a lack of attention to correlated duties, Schlager and Ostrom also appear to conflate rights and powers. The Schlager-Ostrom framework splits their rights bundles into two separate categories: what they define as operational-level decisions and collective-choice decisions. As argued here, however, bundles defined by Schlager and Ostrom as collective-choice-level rights are more appropriately defined as powers, or the authorization to alter relations between individuals, specifically the operational-level rights of access and withdrawal.

Viewing the Schlager-Ostrom framework in the context of both powers and rights, along

TABLE 4  
Revised Schlager-Ostrom Framework, Featuring Both Right Bundles/Correlated Duties and Powers/Correlated Liabilities, and the Implications of Both Holding and Not Holding a Given Right or Power

Right	Duty	
	Right Not Held	Right Held
Access	Do not access	Respect terms
Withdrawal	Do not obtain resource	Respect terms
Power	Liability	
	Power Not Held	Power Held
Management	Vulnerable to this and higher-order decisions	Vulnerable to higher-order decisions only
Alteration	Vulnerable to this and higher-order decisions	Vulnerable to higher-order decisions only
Exclusion	Vulnerable to this and higher-order decisions	Vulnerable to higher-order decisions only
Alienation	Vulnerable to alienation	Vulnerable to changes in formal (de jure) or informal (de facto) rule structures only

with their correlates of liabilities and duties, the five-bundle hierarchy introduced some 20 years ago expands significantly (Table 4). Seen in this expanded diagram are not only the original five bundles, but also the additional “alteration” bundle. We also see the correlated relationships for both rights (“duties”) and powers (“liabilities”). We argue that this expanded framework is necessary to fully appreciate the nuances and complexities of common property regime decision making.

In natural resource management policy formulation and implementation, formal property rights are enacted or reformed with the underlying assumption that rights will be realized at the operational level; that is, the duties and powers inherent in those rights will be recognized and internalized by resource users. Duties and powers apply to each of the property rights identified above. Our foray into duties and powers is particularly relevant for contemporary natural resource management issues that increasingly involve contractual agreements designed to guarantee a stock or flow of goods and services over a given time horizon. This focus on contracts and formalized obligations requires a clear understanding and documentation of the full suite of rights and responsibilities that characterize a given system.

This added focus on the linkage between rights and responsibilities can be viewed in the context of another trend in natural resource policy, the increasing separation of goods and services (Beymer-Farris and Bassett 2012). For example, a forest may no longer be viewed as just a forest, but as a collection of land, trees, and carbon, each of which could be contracted for separately. The Schlager-Ostrom bundles framework does not have provision for substantive alteration of the stock and flow of goods and services, aspects that have significant implications for fulfilling terms of medium- to long-run contracts. As such, both aspects of the revised bundles framework—an increased focus on responsibilities and the addition of alteration—are interrelated and serve to improve the application of the Schlager-Ostrom framework to contemporary natural resource policy issues. Below, we turn our attention to an application of the revised framework.

III. APPLYING THE REVISED  
FRAMEWORK: THE EXAMPLE OF  
REDD+

REDD+ is a mechanism to both enhance existing forest carbon stocks and reduce deforestation and forest degradation, for the pur-

pose of mitigating the effects of climate change. REDD+ is particularly complex from a property rights perspective because it simultaneously operates at multiple scales and involves the consideration of rights to land, trees, carbon, and other forest-related goods and services (e.g., Takacs 2009). An advantage of placing REDD+ activities in the context of our revised property rights framework is the increased ease of evaluating the complex relations typifying common pool resources (CPR) management regimes simultaneously occurring in the context of these external policy drivers and contractual obligations. The focus of REDD+ on maintaining and improving forest condition benefits from our increased attention to alteration, while the role of obligations to maintain these conditions over time speaks to our focus on correlated responsibilities, making REDD+ an appropriate test case for our revised framework.

### A Revised Framework and REDD+

The success of REDD+ hinges on the resolution of several oft-cited impediments. A primary hurdle to REDD+ is forest tenure. As Streck (2009, 154) defines it, tenure “determines who can use what resource, for how long and under what conditions.” Unclear or “diluted” responsibilities can lead to deforestation (Streck 2009, 154), and secure tenure, along with the availability of appropriate economic incentives, and opportunities for participation in program design and implementation, are therefore viewed as being a necessary first step in local community engagement in REDD+ activities (Lwlor, Weinthal, and Olander 2010).

The picture of REDD+ is further complicated in that implementation requires not only the resolution of existing rights, but also the assignment of new ones, specifically as they relate to carbon (Streck 2009). On one hand, it can be difficult to assign clear property rights to ecological services due to their inherent interconnectedness and linkages to other services and systems (Costanza and Folke 1996). For example, allocation of the benefits of carbon storage among multiple users is difficult in an environment characterized by unclear or shifting resource bound-

aries (Roncoli et al. 2007). The multiple attributes present in a forested system likewise complicate resolution of property rights. Much as the rights may be bundled, so too may be the resource itself. In a given forested area, one has land, trees, carbon, and countless other attributes. CPR regimes may also be characterized by what Kundhlande and Luckert (1998) refer to as *multiple tenures*, or the allocation of one set of property rights for the land, another for specific goods or services coming from the forest itself (e.g., timber, nontimber forest products, carbon). The biophysical relationship between carbon and these other attributes implies that the allocation of carbon property rights is dependent upon the allocation of property rights surrounding these other attributes. From a resource typology perspective, however, forest carbon storage possesses the attributes most likely to lead users to address both appropriation (e.g., allocation) and provision (e.g., management and protection) issues (Schlager, Blomquist, and Tang 1994). The forest resource is stationary, and the valued commodity, carbon, is bankable or capable of being stored. In and of themselves, these attributes would tend to facilitate the development of fixed rights to forest carbon.

The incentive to manage for the increased productivity and performance of a natural resource system is inherently tied to the ability of individuals or groups to capture the benefits of management and investment (Ostrom and Schlager 1996). Of their five “bundles,” alienation is highlighted as particularly important, as it allows managing individuals to “personally withdraw their share of the accumulated assets resulting from their prior investments in conservation or enhancement activities” (Ostrom and Schlager 1996, 137). Ostrom and Schlager (1996) note that this assertion is largely borne out in the literature, but that other owner positions (e.g., proprietors) may also possess adequate incentives to make investments in the productivity and performance of a resource. Introducing alteration into the realm of proprietor (Table 2) complicates this assertion, as the potential exists for reconfiguration of rights through fundamental change of the underlying resource.



In the context of REDD+, our revised framework allows differentiation between those activities centering on the exercising of management (improved forest management and reduced degradation) and those centering on alteration (afforestation/reforestation and avoided deforestation). For example, improved forest management and reduced degradation both require management powers to initiate activities. Alternatively, afforestation/reforestation activities require positive land use change to initiate (alteration from a non-forest use to forest), while avoided deforestation is predicated upon a *lack* of land use change (i.e., prevented alteration away from forest). We argue that it is the fundamental shift in resource attributes in each of these latter activities that necessitates a distinction between management and alteration.

As the incentives to invest in resource improvement vary by right-holder position, maintenance of activities operating under a REDD+ regime would require not only management powers (in the case of improved forest management and reduced degradation) and alteration powers (in the case of afforestation/reforestation and avoided deforestation), but likely higher-order powers as well. Exclusion is of particular importance, as the ability to exclude activities detrimental to the provision of a service is a key element of payment for ecosystem services (PES) programs, generally (Sunderlin, Larson, and Cronkleton 2009). In a broader context, these higher-order powers are important because they begin to speak to the long-term sustainability of increases in forest carbon storage and reductions in forest carbon emissions, the joint greenhouse gas mitigation objectives of REDD+. The revised framework introduced here highlights the important distinctions between these rights and powers, allowing researchers and policy makers to focus on the connection between specific activities and the particulars of a given property rights regime in observing the effectiveness of REDD+ initiatives. The enhanced focus on correlated duties and liabilities likewise allows for a greater investigation of the effect of permanence requirements that are likely to be imposed on individual REDD+ project activities.

## The Example of Permanence

A unique attribute of terrestrial carbon storage is its inherent nonpermanence, or the potential for stored carbon to be reemitted back to the atmosphere (Cooley et al. 2012). This presents an important distinction between carbon and other commodity markets, that the “use” or “extraction” of the resource comes with additional strings attached. There is an obligation to maintain that carbon long after it is sold.

Even in those analyses focusing on carbon storage on forest commons, the literature is generally silent on the issue of liability for loss and obligations to maintain storage (e.g., Chhatre and Agrawal 2009), though notable exceptions do exist. Dutschke and Angelsen (2008), for example, identify nonpermanence as an important concern in REDD, arguing that assignment of liability is a necessary precondition to ensure resulting credit fungibility in larger carbon markets. Palmer (2011) discusses the importance of assigning liability in the context of REDD+, and the link between it, property rights, and various institutional frameworks in determining reversal risk. Takacs (2009) meanwhile provides a discussion generally limited to the legal and tenure issues associated with REDD+ but presents a cautionary note that liability for underperformance and reversals is important to clearly delineate at the outset. Takacs (2009, 63) echoes the conflict present in other works on the subject, on one hand calling for clear delineation of both rights and responsibilities in either laws or contractual provisions so as to avoid future conflicts, but on the other noting that “forest carbon ‘law’ should be pluralistic,” that it should “encompass local, informal legal arrangements.” The Forests Dialogue (2008) speaks to the inability of forest-dependent peoples to assume the risk (loosely defined) associated with carbon market participation. They argue, somewhat counter to Takacs (2009), that as of the date of the article “few countries have begun to address the property rights issues surrounding carbon sequestration, emissions, and trade” (The Forests Dialogue 2008, 3–4), concluding with a call for clearly defined rights for the benefit of “the forest-dependent poor.”

Regardless of the policy structure through which REDD+ activities are to be implemented, it is likely that liability for carbon loss will need to be addressed somewhere, somehow. Under situations like the comanagement framework reviewed by Palmer (2011), liability for carbon loss must be assigned so as to reduce deforestation and forest degradation incentives. If REDD+ activities are occurring as individual projects or if carbon reductions emerging from REDD+ are to be traded in some larger carbon market, the assignment of liability for reversal is of utmost importance (Dutschke and Angelsen 2008; Streck 2009).

Returning to the revised framework outlined in Table 4, the assignment of liability to affected groups and individuals is facilitated by first correctly distinguishing between powers and rights. As Schlager and Ostrom appropriately capture the important distinction between what they term operational and collective-choice decision making, the primary advantage of the revised framework in this regard is a simple correction of terminology. Literature outlining legal relations between parties has traditionally labeled the authorization to modify operational-level decisions as a power. In the context of liability for carbon reversal, this correction in terminology can help to unite what is at present a contract law-centric discussion in the carbon market literature (e.g., MacKenzie, Ohndorf, and Palmer 2012) and the literature on forest management, property rights, and tenure to which the Schlager-Ostrom framework is more directly applied. Turning to the correlate of power, the explicit recognition of the liability imposed by a lack of power can allow for an increased focus on the incentives to improve, transform, or alter a resource.

The greater contribution of the revised framework is on the issue of rights and their correlated duties. This is observable in the case of access and withdrawal rights in REDD+ activities, the decision levels where carbon sequestration is operationalized. Rights to receive some benefit for the increased carbon now stored in the forest arguably come with the duty not to withdraw other attributes that detrimentally affect carbon storage, a duty that, as explored below, may or may not be allocated through formal

contract. The question is, in the case of carbon mitigation achieved through REDD+ activities, is this restriction better characterized as a modification of rights to these other attributes, or as an imposition of duties to the carbon buyer, larger carbon registry, or state or other entity providing benefits in exchange for carbon storage?

A focus on both rights *and* duties allows for exploration of this question. Returning to Hohfeld's analysis of in rem and in personam duties, we can imagine the duty side of the equation in Table 4 to be broken down by relation, ranging from obligations to individuals (e.g., funding entity, carbon benefit provider) or multiple individuals (e.g., community). A focus on correlated rights and duties facilitates this distinction to be observed (Figure 1). We argue that conceptualizing the framework in this manner allows for deeper exploration into issues of forest carbon liability, itself an issue recognized for its complexity and multiple avenues for resolution under the auspices of REDD+ (Palmer 2011).

Having isolated a particular relationship, we can now focus on the larger rule structures into which they are embedded. These rule structures play a defining role in the exercising of both rights and duties, particularly through the provision and direction of incentives. Changing rule structures are highlighted by the gray arrows in Figure 1, representing the allocation of rights and duties across land use and institutional contexts.

The first example in Figure 1 (pastoral agriculture to afforestation) represents a PES-type scheme, in which an outside entity purchases carbon credits for carbon stored. In this example, we see that the primary change in moving from Use A to Use B is the allocation of additional powers to the entity purchasing the carbon credits yielded by the afforestation project. This represents an additional provision of what we could call in personam powers to the funding entity while preserving but slightly modifying the in rem allocation of rights and powers among the community itself. Note also the allocation of new duties to both the funding entity and the community, as there is now a contractual obligation for the community to maintain the carbon and a contractual obligation for the funding entity to

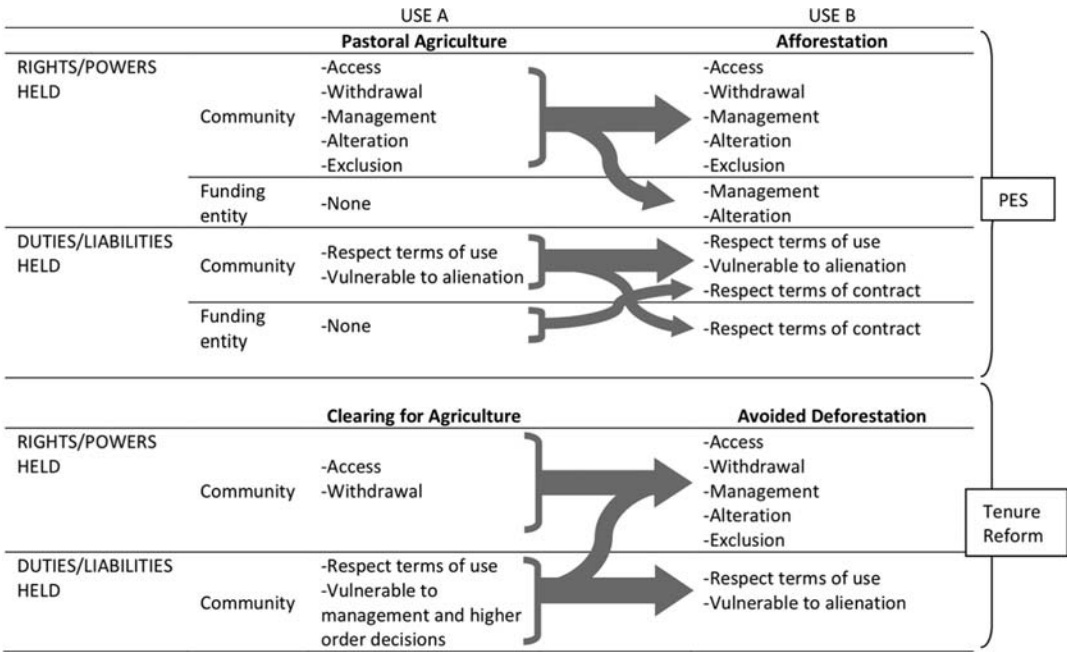


FIGURE 1

Overview of Two Hypothetical Land Use Alterations Taking Place under the Auspices of a REDD+ Program

pay for this stored carbon. The second example (clearing for agriculture to avoided deforestation) is perhaps best seen in the context of tenure reform, in which additional powers are secured allowing for investments to be made to existing resources. Here, the primary change is the change of in rem management, alteration, and exclusion liabilities to powers. Community-defined terms of use remain, as does liability to state-imposed alienation decisions, but increased powers have been given to the community to make management, alteration, and exclusion decisions. It is these new powers that could dramatically alter the incentives to avoid conversion to agriculture in favor of maintained forest cover.

Streck (2009) makes the clear connection between payments under REDD+ and an associated loss of rights. The PES example detailed in Figure 1 gives credence to this claim. Here, the provision of some service (i.e., the storage of carbon) is paid for by some outside entity. In entering into such an agreement, the power to manage and alter land use is now partially contractually obligated to that entity

so as to ensure the continued availability of that service. The tenure reform example is typified in research by Chhatre and Agrawal (2009), who find that greater rule-making autonomy can result in higher levels of carbon storage. It also represents the recurrent theme in the literature calling tenure reform a necessary prerequisite to reduced deforestation (e.g., Streck 2009; Lawlor, Weinthal, and Olander 2010; Sandbrook et al. 2010). Modifying the tenure reform example to include some direct payment for avoided carbon emissions (thus making it more akin to the PES example), we begin to approach a situation discussed by Milne (2012, 704) in which “local property rights were both recognized and taken away at the same time.” In such a situation, we would retain both the branched arrows of the PES example indicating the transfer of powers and imposition of new duties and the transfer of liabilities to powers indicated in the tenure reform example.

The complex interplay of new duties and liabilities alongside the allocation of new rights and powers requires a framework ca-

pable of distinguishing between each. The revised framework presented here allows, for example, clearer distinction between carbon-related duties and those relating to access, withdrawal, and management of other resources (e.g., timber, water, minerals). It also allows for comparative analysis of multiple property rights regimes and their ultimate effect on the permanence of stored carbon. Larson, Barry, and Dahal (2010, 91), for example, argue that “the management portion of the bundle of rights is being spliced in ways that guarantee that the state will continue to play a central role in decision making.” In the presence of such “splicing away,” what are the observed differences specifically from a carbon storage perspective between reforms that splice management rights versus those that splice alteration? And are there observed differences in the permanence of carbon storage between the two?

Examination of a few early carbon storage projects can further reinforce the potential benefit of a revised framework. One such example is the Kariba REDD+ Project operating under the Verified Carbon Standard (von Laer et al. 2012). The project began in July of 2011 and covers nearly 785,000 ha of woodland forest in northwest Zimbabwe. The project land falls across four separate provinces and is partially administered by Carbon Green Investment (CGI), the project proponent, and four local rural district councils (RDCs). The project consists of several activities intended to prevent additional deforestation and to improve degraded forest lands, including the promotion of sustainable agricultural techniques, fuelwood plantation establishment, fire management activities, monitoring and patrols, and the establishment of a community sustainable fund. Through a series of contracts, carbon revenue generated by the project is to be allocated among both CGI and the four RDCs, a formula for which is detailed in the project description document. The interactions between the rights to make use of forests, the rights to carbon finance proceeds, the obligations to further project objectives, and by extension, the implications of any future reversals are precisely the complex issues the revised framework are intended to address. With specific regard to alteration, identifying

it as a separate bundle is useful to explore the implications of plantation establishment and other projects in which a change in land use could be expected. Indeed, preventing the area from being “cleared for non-sustainable alternative land-use scenarios” was a primary motivation in establishment of the project (von Laer et al. 2012, 4).

Contrast this to the Humbo Assisted Natural Regeneration Project in Ethiopia, registered under the Clean Development Mechanism in December 2009 (Biocarbon Fund 2009). The revised framework introduced here is helpful in exploring the apportionment of responsibility for stock maintenance against the rights to future carbon revenue. The considerable effort devoted in project documents to clarify carbon rights, landholding rights, and the roles and responsibilities of key project stakeholders likewise speaks to the relevance of the revised framework (Biocarbon Fund 2009, Annex 5). The value added by the alteration bundle is less clear in this example, however, as project documentation does not discuss project activities in fine enough detail to distinguish between management and alteration.

#### IV. CONCLUSION

Having proposed a revision to Schlager and Ostrom’s seminal framework, are there clear advantages to be gained in the application of the proposed modification? We argue that there are. By drawing attention to the correlates to rights and powers, the traditional focuses of analysis, we bridge the legal and institutions literature and show how an increased focus on duties can yield increased insight into the relations that define the incentives for greenhouse gas mitigation through the imposition of various rule structures. By embedding a sixth bundle—alteration—we allow the framework to be more responsive to the nuances of resource management situations such as REDD+ other PES mechanisms that involve fundamental changes in the attributes of resources.

An inherent limitation in the revised framework is its increased complexity over the original. As noted above, this additional complexity may complicate application. Any dis-



cussion of correlated rights and duties should likewise bear in mind a cautionary note from Bromley (1991, 50) that “instances of actual rights and correlated duties are best thought of as situations where the law is reasonably clear,” implying that application of the revised framework discussed here could be difficult in situations of unclear or overlapping tenure systems. The true value of the revised framework will therefore be realized only with future application.

To that end, we envision several possible outlets. First and foremost, we believe that there is value in revisiting previous studies conducted using the original Schlager-Ostrom framework to evaluate the benefits of using the revised framework developed here. The examples reviewed here also largely relate to terrestrial land use change. Work should be devoted to examining the applicability of the revised framework to other natural resource contexts, for instance, the explicit or implicit allocation of alteration powers in activities that affect water quantity, water quality, and/or fisheries directly. Multiple examples likewise exist in Western legal and policy contexts in which an increased attention to both rights and duties would be beneficial and provide further opportunity to explore alignment of Schlager and Ostrom’s work with Honoré’s and other seminal works of property rights and ownership.

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