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After decades of climate policy development, global attention has recently shifted to the mitigation potential of terrestrial ecosystems. The focus is on the world's remaining tropical forests and how developing countries can reduce rates of forest loss while encouraging sustainable development and land-use. Since it was introduced at COP-15 in Montreal in 2005, the program Reducing Emissions from Deforestation and Forest Degradation (REDD+) has supported many tropical countries to develop carbon mitigation initiatives. REDD+ has accelerated national and sub-national policy reforms in the forestry sector and the development of on-the-ground carbon forestry projects. The majority of these initiatives are funded through climate aid from multi-lateral and bilateral donors that has targeted cross scale institution building, technology transfers, and in some countries greater involvement of local communities. However, managing carbon in terrestrial ecosystems remains a challenging and problematic undertaking. In developing countries, forests are commonly subject to multiple and competing claims leading to regular disputes between the state, private interests, and forest-dependent communities. Many countries also lack the administrative capacities or political motivation to control deforestation and illegal logging within their territories.

The Kyoto Protocol, the Clean Development Mechanism (CDM), and carbon markets more generally have encouraged broad research on the governance of climate change and carbon.[1] This research has focused on governance through voluntary and compliance-based carbon markets and the practices of carbon offsetting, including numerous case studies from forest projects in developing countries.[2] These studies direct attention towards the agency and the shifting authority of public and private actors engaged in market governance, its transnational nature, and the mode or form that governance adopts.[3] For example, the CDM represents a hybrid form of administrative hierarchy with significant regulation by international and national bodies, while the voluntary market operates as a networked domain under the authority of private and civil society actors.[4] Carbon offsets and markets have also been analyzed from a gov-

1. See Biermann et al. 2011; Bulkeley and Newell 2010; Newell and Paterson 2010.
2. For example, see Boyd 2009.
3. See Pattberg and Stripple 2008; Stripple 2010.
4. Bumpus and Liverman 2008, 150.

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ernmentality perspective. These studies focus on the ways that carbon is made into a calculable and standardized commodity, and how individuals and organizations become the subjects or agents of carbon offset governance.[5]

Despite the importance of the CDM and voluntary markets in climate governance, forestry offset projects remain a relatively small component of overall credit transactions. Carbon markets do, however, influence how industrialized and developing countries design and implement GHG mitigation policies in the forestry and land use sectors. Many REDD+ projects plan to sell credits into voluntary carbon markets, and subject to international agreement, to global and regional compliance markets. Country based REDD+ initiatives support the development of a carbon offset market, but these components are often part of a much broader climate change and forestry reform agenda. These broader initiatives include the preparation of national REDD+mitigation strategies and the development of measurement, monitoring, reporting and verification (MRV) systems. Developing countries are also reforming land-use planning and development frameworks, or introducing regulations to control illegal logging and bolstering enforcement in conservation areas.[6] National governments and their partners from multilateral agencies and NGOs are also attempting to implement safeguards to address issues such as equitable distribution of finance and benefits, and resolving land tenure and carbon rights issues.[7] These programs often require the engagement of multiple public and private stakeholders, including local indigenous communities and business interests. The sheer variety and complexity of activities raises important questions about how mitigation programs are governed, and how different state, private, and civil society agents conduct reforms.

This article explores these questions by applying a governmentality framework[8] to investigate the different policy instruments and techniques used to govern carbon in terrestrial ecosystems. The article uses a selection of primary and secondary material from the emerging literature on mitigation in the land-use, land-use change and forestry (LULUCF), and agricultural sectors.[9] Both developed and developing countries are evaluated, but a greater emphasis is placed on REDD+ programs and activities in developing countries. The first section develops a governmentality framework to analyze policy instruments, processes, and forms of knowledge that state and non-state agents use to govern

5. Gupta et al. 2012; Lövbrand and Stripple 2011; Lovell and Liverman 2010; Paterson and Stripple 2010.
6. See Di Grigorio et al. 2012; Agrawal et al. 2011.
7. Chhatre et al. 2012; Jagger et al. 2012.
8. Foucault 1991; Dean 2010; Miller and Rose 2008; Okereke et al 2009; Kronsell and Backstrand 2010.
9. Under the Marrakesh Accords activities for the LULUCF and agricultural sectors cover afforestation; reforestation; deforestation; forest management; cropland management; grazing land management; revegetation; rice cultivation; agricultural soils; prescribed burning of savannahs; field burning of agricultural residues. Enteric fermentation, manure and fertilizer management are excluded.

ecosystem carbon. The second section applies this governmentality framework to the development of REDD+ national reforms and sub-national demonstration activities in developing countries. Although there is variance between different countries and locations, there are a number of common policy reforms and instruments applied across jurisdictions indicating a degree of convergence in mitigation activities. The application of international rules and highly standardized methods to account for carbon is also driving convergence in LULUCF mitigation policies and programs.

I argue that state and non-state agents employ three main governing logics or rationalities to manage carbon in ecosystems: administrative, economic, and deliberative/participatory approaches. Each rationality is associated with governmental technologies, such as policy instruments, processes, and techniques that enable carbon to be governed in different countries and locations. Technologies include regulations and planning policies administered by public authorities, market and incentive instruments, and multi-stakeholder engagement processes.

Carbon mitigation in the LULUCF and agriculture sector is primarily controlled or steered by public authorities, who design, implement and manage the majority of policies or programs. In the case of REDD+, significant policy reform is targeting the re-regulation of the forestry and land-use sectors using traditional "command and control" policies, centralized or decentralized planning, and increased surveillance and enforcement of illegal logging.[10] There are numerous carbon incentive programs and offset projects, but these are also dependent on government or international policy and regulation.[11] Consequently, in a number of developing countries REDD+ is recentering the role and power of government agencies as the primary agents through which carbon mitigation programs are formulated and implemented. States use the regulatory and technical reforms adopted as part of national and sub-national mitigation efforts to reaffirm and, in many cases, extend their authority to govern sovereign forest resources and land. This creates significant challenges in implementing effective and equitable mitigation programs when governments are weak,[12] and power often remains entrenched within collusive government and business interests.[13] External agents, such as donor agencies, NGOs, and the private sector currently have relatively circumscribed roles supporting the efforts of central and sub-national authorities or setting up pilot demonstration projects.

Governmentality

A governmentality perspective provides one approach for investigating complex climate change programs and activities and the associated authority of state and

10. For country profiles see, Indrarto et al. 2012; Pham et al. 2012; May et al. 2011.
11. Sunderlin and Sills 2012.
12. Karsenty and Ongolo 2012.
13. Di Gregorio et al. 2012; Brockhaus et al. 2012, 33; May et al. 2011, 20.

non-state actors.[14] Governmentality analysis understands government as a complex form of productive power embodied in multiple ways of thinking and acting that governs the activities of populations.[15] Government in this usage is a broad concept that refers to the conduct of conduct or any calculated and rational activity, undertaken by different authorities and agencies.[16] The creation and deployment of knowledge is central to how different agents exercise control over peoples' lives through calculation, experimentation, and observation. The practice of modern government, however, is not restricted to programs conducted exclusively by the state, but is a sum of all processes and activities that shape the social order and individual actions. This relates not only to the policies and techniques through which states and populations are governed, but also the ways in which populations and groups actively govern themselves.[17] For the purposes of this article the broader definition of government as a form of rule will be used.

A governmentality approach enables us to identify the underlying rationalities that underpin a particular process or method of governing.[18] Governmental rationalities determine what social and economic activities or physical systems can or should be governed, and the particular methods, instruments, or practices of governing. Different rationalities legitimize certain ways of managing issues and underpin the principles that drive various approaches to governing or transforming society. Rationalities are not necessarily universal forms of reason but are part of the practices of governing and are tied to particular discursive fields and types of knowledge, and ways of visualizing problems and responses.[19]

In the environmental policy domain, three broad rationalities underpin responses to environmental issues and problems.[20] The first, *administrative rationalism*, is often associated with the institutions of the bureaucratic state and an emphasis on professional expertise and scientific knowledge.[21] Government agencies often apply regulatory policy instruments delivered through top-down and hierarchical decision-making. The second, *economic rationalism*, uses price signals, marketing, and education to change production and consumption patterns.[22] In contrast, *deliberative* or *participatory rationalities* focus on solving environmental problems through engagement, debate, and communication among multiple social groups and stakeholders.[23]

These different rationalities engage practices or 'technologies' that facili-

14. Okereke et al. 2009, 72; Oels 2005, 203.
15. Foucault 1991.
16. Dean 2010, 18.
17. Miller and Rose 2008.
18. Miller and Rose 2008.
19. Dean 2010.
20. Kronsell and Bäckstrand 2010.
21. Dryzek 2005.
22. Dryzek 2005, 125.
23. Baber and Bartlett 2005.

tate the deployment of particular government programs.[24] Technologies enable the rationalities or ways of thinking about a problem or issue to be put into action. These technologies do not merely accompany rationalities, but rather establish the domains of rule,[25] and shape how the public authorities, civil society and private agents deploy political authority. There are multiple governmental technologies, such as policy instruments and processes, methods of calculation and measurement, and particular forms of knowledge.[26] They encompass different mechanisms for controlling and steering populations, and means to facilitate performance and agency. For example, technologies of performance determine what knowledge is legitimate and specify outcomes from activities, such as through norms, audits, benchmarking processes, and systems of accreditation.[27] Technologies of agency include different forms of participation and engagement, the formation of partnerships, and more formal contracts among governing actors.

Ecosystem Carbon

Governmental rationalities and associated technologies provide a framework to understand the logic and action behind different initiatives designed to manage ecosystem carbon. Terrestrial ecosystems, such as native forests and wetlands or managed agricultural lands, are subject to multiple natural processes and human interventions that have a major effect on the global climate. Reducing GHG emissions and increasing sequestration in terrestrial ecosystems represents an important short-term option for stabilizing global climate change. Achieving this outcome involves an array of different land-use activities designed to manage the carbon stored in vegetation and soils. In native forests, for example, conservation programs can aim to limit deforestation and introduce sustainable forest management practices.[28] In agricultural landscapes, activities often involve carbon sequestration, such as reforestation projects or the introduction of new grazing and cropping systems.[29] These diverse activities entail a complex spatial component, operating over vast landscapes and in multiple specific locations. At one end of the spectrum are private smallholder plantations, and at the other extreme are tropical rainforest conservation programs extending over millions of hectares.

Governing ecosystem carbon involves a regime of practices operating across multiple levels and scales, from international agreements to national reform programs and local projects and interventions. These practices aim to control and steer the behavior of multiple public and private agents and reconfigure

24. Miller and Rose 2008, 63; Dean 2010.
25. Okereke et al. 2009, 72.
26. Gouldson and Bebbington 2007, 14.
27. Dean 2010, 195.
28. Nabuurs et al. 2007, 549.
29. Smith et al. 2007.

how they exploit and manage land and natural resources. The application of policies and programs to reduce GHG emissions and sequester carbon does vary according to individual country circumstances related to forestry and land use, and rights and access to resources.[30] For example, land tenure systems and forest management regimes do vary substantially between and within countries.[31] Different systems of government, such as democratic or authoritarian rule, also influence the policies selected and the way governance reform programs are conducted.[32] However, the current series of mitigation programs operating across multiple locations and jurisdictions function according to broadly consistent rationalities and technologies. Developed and developing country governments employ a common set of policy instruments and administrative reforms, apply similar accounting practices, and use common scientific methods and information (see Table 1). This convergence is to a degree driven by the rules and modalities adopted though international climate negotiations and by the rigorous standardization of MRV systems and carbon accounting demanded from carbon markets.

Rules, Regulations, and Markets

The domain of ecosystem carbon governance is subject to substantial influence from the large international climate bureaucracy established under the United Nations Framework Convention on Climate Change (UNFCCC), which determines how countries can incorporate ecosystem carbon activities into domestic emissions reduction programs and targets.[33] For the LULUCF sector, rules and modalities were negotiated through the Kyoto Protocol and further elaborated in the Marrakesh Accords in 2003. The Kyoto Protocol allows for Annex 1 (developed) countries to nominate land-use and forestry activities to contribute towards meeting domestic emissions reduction targets in the first commitment period covering 2008–2012. The rationale underpinning LULUCF administration is highly technocratic management based on scientific measurement and complex accounting systems.[34] The UNFCCC and Kyoto Protocol are controlled by a centralized and hierarchical administrative apparatus that oversees a collection of binding agreements, rules, guidelines, and standardized operating procedures.[35] The global climate bureaucracy also audits compliance of national governments with international commitments and reporting guidelines. These methods of carbon accountability and review create a frame to view the programs of national governments and to standardize and and make comparable diverse GHG sources (including forest ecosystems and communities).[36]

30. See examples, Dilling 2007; Boyd 2009.
31. Larson et al. 2012.
32. Di Gregorio et al. 2012; McCarthy and Tacconi 2011.
33. Höhne et al. 2007; Streck and Scholz 2006.
34. Höhne et al. 2007; Bäckstrand and Lövbrand 2006, 62.
35. Bulkeley and Newell 2010; Stripple 2010, 75.
36. Lövbrand and Stripple 2011.

Table 1
Rationalities and Technologies[a]

		Technologies	
Delivery Mode	*Actors*	*Control/Steering*	*Agency/Performance*
		Administrative	
Bureaucratic hierarchy Top-down administration	Multilateral agencies National and sub-national governments	Agreements Rule systems Regulations Planning instruments Budgets Public subsidies Compliance markets Taxes	National MRV Consultation processes Standards
		Economic	
Private markets linked through commodity chain	Governments Private/corporate Landowners NGOs	Compliance markets and taxes Voluntary offset markets Incentives (PES) Private finance Product labeling Certification	Project MRV Standards Contracts
		Deliberative	
Participatory networks	Governments NGOs Private/corporate Communities	Partnerships Contracts Knowledge transfer and exchange	Engagement forums Consultation processes Free prior and informed consent

a. Adapted from Kronsell and Bäckstrand 2010.

At the national level, many of the policy reforms targeting mitigation in the LULUCF and agriculture sectors represent the techno-managerial approach of administrative rationalism. These interventions follow more traditional "command and control" laws or adjustments to land-use policies supported by sophisticated land-use data and satellite-based vegetation mapping. Countries incorporate mitigation into a range of traditional regulatory and planning-based policy instruments. GHG mitigation has been mainstreamed into natural resource management and forest policies, such as protected area systems, vegetation controls, and sustainable harvesting programs.[37] In agriculture and rangelands, policies that reduce emissions have focused on existing soil and vegetation management programs and planning controls on agricultural expansion.[38]

National and sub-national authorities in Australia, for example, substantially reduced emissions from deforestation after 1990 through technology improvements and new regulations that controlled or limited vegetation clearing on pastoral and cropping lands, particularly in the state of Queensland.[39] These policy instruments represent technologies of control that central and sub-national bureaucracies deploy to legally regulate and enforce the activities of private landholders and business operators. They require operators to meet standard performance criteria but often allow some flexibility for local conditions and a degree of decentralized implementation.

In addition to regulations, countries also apply economic rationalities to carbon mitigation in the LULUCF and agriculture sectors. Public agencies and private companies are experimenting with market and incentive-based instruments to achieve mitigation targets, such as emissions trading schemes (ETS), carbon taxes, forest certification, and carbon disclosure programs. Forestry projects are now incorporated in voluntary offset markets or regulated carbon markets, such as the CDM, the New Zealand ETS, the Australian carbon tax/ETS (which also includes agriculture offsets), and the California cap and trade scheme. In regulated markets the price of offset "credits" is determined by a cap on tradable credits, and buyers are either private companies or governments with emissions liabilities.[40]

Carbon markets focus on assigning a "price" and establishing a "property right" to facilitate trading in carbon credits from activities which sequester or retain carbon in ecosystems, such as forestry plantations or conservation projects.[41] Certification and carbon disclosure programs provide information to consumers about products to influence consumption patterns. These economic approaches rest on the logic that practices that cause GHG emissions are excluded from the private individual costs of production and consumption.[42]

37. Nabuurs et al. 2007.
38. Smith et al. 2007.
39. Garnaut 2008; for a contrary view Macintosh 2012.
40. Newell and Paterson 2010.
41. Portela et al. 2008, 14.
42. Portela et al. 2008, 14.

These instruments operate as technologies of steering, providing an incentive for people to undertake certain practices that reduce emissions. Rather than stringent regulations, the aim is to permit flexible mitigation options and encourage citizens and companies to become active subjects and consumers in carbon offsetting.[43] Many of these market or incentive instruments are governed through a combination of centralized state administration and networked private regulation. Global markets such as the CDM operate as a form of administrative rationalism based on highly technical and hierarchical regulation through the CDM executive board and national governments.[44] This regulation also results in stringent standards and processes for afforestation and reforestation projects under the CDM.[45] Similarly in Australia's carbon tax/ETS, the inclusion of carbon sequestration credits from forestry and agriculture projects is subject to highly centralized regulation and monitoring by the national government.[46] These market instruments effectively re-regulate forestry and land-use sectors, often extending state oversight over activities on public and private property. In contrast, the much smaller voluntary carbon offset markets operate according to a more flexible administration by private actors, involving transnational networks of businesses collaborating with project developers such as NGOs and private landowners.[47] States maintain an oversight role through voluntary offset guidelines and regulations, and by administering land-use planning, regulatory approvals, and licensing functions.

Deliberation and Carbon Accounting

The exercise of different rationalities and technologies point to the expanding role of public agencies in initiating and implementing mitigation activities in the LULUCF and agriculture sectors. But public bureaucracies also bring other actors aboard the reform process to change broad economic trajectories and social attitudes that cause forest loss and soil degradation. Deliberative approaches are widely applied to engage multiple stakeholders in governing ecosystem carbon. Deliberative rationalities rest on normative assumptions regarding the benefits of participation by a cross-section of public and private actors in delivering legitimate and effective policy outcomes.[48]

Managing carbon across large landscapes, with multiple land tenures and diverse economic and social uses, necessarily involves public authorities, private landholders, and communities. Case studies from carbon forest projects in China, Ecuador, and Mexico indicate that different stakeholders also have complex and often contested relationships around how land is managed as a social

43. Lovell et al. 2009, 2360; Paterson and Stripple 2010.
44. Stripple 2010.
45. Streck and Scholz 2006, 862.
46. Macintosh and Waugh 2012.
47. Bumpus and Liverman 2008, 140.
48. Baber and Bartlett 2005.

and cultural resource, and this affects access to potential economic benefits.[49] Research on forest carbon projects under the CDM,[50] and on payments for ecosystem services (PES) projects in Mexico,[51] suggests that participation by landowners at multiple stages of the project cycle can prove more effective and equitable as these stakeholders are granted ownership and a share of financial returns.

Deliberative approaches to carbon mitigation often involve processes of consultation, stakeholder engagement, and partnerships or contracts. These represent particular technologies of agency to integrate multiple stakeholders into a particular reform agenda or development activity. They operate as technologies through which knowledge is bounded and transferred into actions on the ground, thereby shaping actors' roles and responsibilities. These consultation technologies are often combined with other policy processes, such as national strategy development, local land-use planning or the operation of market instruments. Under the CDM, for example, formal consultation and participation processes engage local stakeholders at different stages of the project cycle,[52] although these processes are not always effective or equitable for landowners. Examples from carbon offsetting projects in Mexico suggest that formal contractual arrangements between sellers and buyers of carbon credits aim to bind a network of landowners, sellers and consumers into the operation of forestry projects.[53]

Technologies of agency facilitate increased roles for non-state actors, but they also permit public agencies to expand authority by legitimizing particular interventions. Indeed, government agencies often conduct consultation and participation processes to legitimize national policy reforms or public investment in the forestry and agriculture sectors. In the CDM, by contrast, formal partnerships engage NGOs and business interests in some administrative functions, such as rule-setting, designing and operating projects, and conducting stakeholder training programs.[54] In the voluntary carbon market, private carbon companies, in collaboration with environment and development NGOs, perform the majority of functions, including project financing, market operation, and standard verification processes.[55] However, these projects remain relatively small and few in number compared to the numerous mitigation programs and policy reforms conducted in the LULUCF and agriculture sectors in many countries. As a result, the authority of non-state actors is also relatively constrained within project activities or as advisors to national and sub-national governments on mitigation programs.

49. Corbera and Brown 2010, 1758.
50. Boyd et al. 2007, 257.
51. Kosoy et al. 2008, 2082.
52. Stripple 2010.
53. Corbera and Brown 2008, 1969.
54. Pattberg and Stripple 2008, 375.
55. Bayon et al. 2007; Peters-Stanley et al. 2012.

Accounting for carbon using measurement, reporting, and verification (MRV) systems has also become a universally deployed governmental technology.[56] Under the global climate regime, countries are required to conduct annual MRV for the LULUCF and agriculture sectors. MRV systems operate with principles of sophisticated scientific measurement and accounting that comply with internationally recognized standards and guidelines developed by the Intergovernmental Panel on Climate Change (IPCC). This expert-oriented approach constitutes a form of green techno-governmentality,[57] based on satellite imagery, computer modeling, and highly specialized knowledge of carbon emissions from ecosystems in multiple locations around the globe. The requirement for detailed and increasingly precise MRV has resulted in countries establishing centralized reporting facilities as part of the broader climate change administration. MRV facilities form an important component of techno-rationality defining which components or attributes of ecosystem carbon can be legitimately governed. They enable governments to expand monitoring and surveillance of forested lands that remained outside the purview and control of the state. Expanded surveillance power permits bureaucracies to pursue regulatory enforcement and judicial approaches to controlling illegal land-use and forest loss.

MRV institutions underpin the operation of national mitigation programs and are central to the operation of carbon markets, including the certification and accreditation of carbon offset projects from forestry and agriculture. In this regard, MRV operates as a performance mechanism that actively determines the boundaries and legitimacy of particular policies and activities. Emissions and sequestration from ecosystems vary greatly subject to different land-use activities and varying climatic zones, creating a high degree of uncertainty in carbon offsets. Sophisticated MRV systems aim to reduce this uncertainty and establish accountability for market transactions between sellers and purchasers of carbon credits. Thus, accounting methods ensure that credits generated from forest offsets become identical, whether generated from pine plantations in New Zealand or from large-scale avoided deforestation projects in the Brazilian Amazon. The accounting practices create the material conditions for an ecosystem carbon commodity with a standard and transferable value equal to one tonne of carbon dioxide from anywhere in the world.[58]

Governing REDD+

REDD+ was introduced at COP-11 in Montreal in 2005 and further developed at COP-13 in Bali in 2007. The subsequent rapid roll-out of REDD+ programs and projects provides an opportunity to analyze how ecosystem carbon is governed in forested and agricultural landscapes in developing countries. REDD+

56. Lovell and Liverman 2010.
57. Bäckstrand and Lövbrand 2006, 54.
58. Mackenzie 2009; Lövbrand and Stripple 2011.

incorporates an array of linked activities that cover avoided deforestation, sustainable forest management, restoration of degraded forest (and peatland ecosystems), and reforestation on cleared land. Over forty developing countries are currently engaged in multiple REDD+ activities and demonstration projects, across the Asia-Pacific, Africa, and Latin America. From a governmentality perspective, REDD+ comprises a regime of practices designed to fundamentally change how multiple agents use and exploit land. The regime involves new forms of knowledge regarding the value of forested ecosystems, methods to measure and account for this value, and new practices for how governments and other agents can legitimately and effectively govern land and forest resources.

The REDD+ initiative as negotiated at the Bali COP in 2013 is built on the principle that industrialized countries will finance measures in developing countries, but there is growing acceptance that REDD+ countries also need to finance domestic mitigation efforts.[59] The initial "readiness" phases of REDD+ are largely financed by multilateral funds set up under the UN-REDD Programme and the World Bank Forest Carbon Partnership Facility (FCPF). Donor countries and NGOs from Europe, North America, and Australasia also financed large bilateral programs and demonstration projects in a number of countries. There is significant variation between developing countries on social and economic conditions, as well as the institutional capacity and political willingness to address deforestation. However, programs initiated by multilateral and bilateral arrangements drive a common range of reforms at the national and sub-national levels.[60] Under the UN-REDD and FCPF programs countries must implement standard policy and administrative reforms, such as preparing a national REDD+ strategy and implementing safeguards supported by an institutional and legal framework.[61] Countries are establishing centralized mechanisms to administer large financial payments to agencies and private or community beneficiaries as part of a future performance-based payment system.

National Reforms

Similar to governing carbon in developed countries, the rationality that underpins many national REDD+ programs and strategies is administrative, focused on institution building and regulatory reforms. The national REDD+ framework design and implementation process is inherently hierarchical and top-down, operating through the bureaucratic and political apparatus of developing countries. Part of building a national REDD+ framework involves substantial changes to how carbon and forest resources are managed by government agencies. Many countries have systemic corruption and accountability problems, often resulting in a failure by agencies to control deforestation and implement

59. Streck 2012.
60. Thompson et al. 2011, 5.
61. See UN-REDD 2011; Jagger et al 2012.

and enforce forest conservation initiatives.[62] This is particularly common in forest frontiers that often remain lawless and outside effective government regulation. REDD+ initiatives often focus on building the capacity of agencies to reform, implement, and enforce existing policy and legislation that reduce forest loss and degradation. In Indonesia and Brazil, key national REDD+ policies focus on improved law enforcement to control high rates of illegal logging in state-controlled production forests and in protected areas.[63] Indonesia is also working to integrate REDD+ objectives into statutory spatial planning laws and harmonize land allocation processes across central, provincial, and district jurisdictions.[64] To deliver policy reforms the Indonesian government is establishing an independent REDD+ agency with administrative oversight functions over legislative reforms and capacity-building programs.[65]

Project Activities

The other governing rationality promoted in REDD+ programs is that of economic incentives, but its application and implementation remain experimental. In many REDD+ countries, forest ecosystems are subject to multiple drivers of deforestation, often large-scale plantation agriculture or industrial logging activities driven by domestic and international markets.[66] Other pressures for forest conversion originate from smallholder agricultural development, often by marginalized poor communities. A range of REDD+ demonstration activities are designed to rectify this "market failure" by providing financial incentives to alter forest and land-use activities and encourage carbon management by landowners, private interests, and public agents. In Asia, Africa, and Latin America, for instance, REDD+ projects test approaches to payments for ecosystem services (PES) and integrated conservation and development projects (ICDP).[67] These projects aim to deliver performance-based payments for activities such as forest conservation and enforcement, livelihood programs, and reduced-impact logging.

There are currently hundreds of REDD+ and other forest carbon projects or sub-national activities around the world, and some are developing a global system of ecosystem carbon commodities.[68] In Peru, for example, analysis of twelve REDD+ projects in the voluntary market suggests that a forest carbon commodity chain is emerging, governed through a series of institutional nodes.[69] This commodity chain initiates a sequential exchange of rights over

62. McCarthy and Tacconi 2011.
63. Government of Indonesia 2012; Indrarto et al 2012; May et al. 2011.
64. Brockhaus et al. 2012, 33.
65. Government of Indonesia 2012.
66. Houghton 2012, 598.
67. Sunderlin and Sills 2012.
68. Projects are currently funded through either voluntary market transactions or aid funding, as REDD+ credits are not yet permitted in global compliance markets.
69. Hajek et al. 2011.

land, forest, and carbon for financial and other social benefits.[70] The exchange also establishes functionally linked governance relationships between diverse and often globally dispersed agents. At one end are carbon service providers and project developers, and at the other are brokers selling credits to private or public buyers in the market.[71] In the design phase projects are independently verified and accredited by private standard companies, which establish the volume and value of credits.[72] This linked mode of carbon governance creates a set of standardized REDD+ carbon offset credits from a diverse range of land-use and forest management activities in multiple locations. Supporting the implementation of market and incentive REDD+ options requires substantial policy and institutional reforms at the national level. In Indonesia, the central government introduced laws to govern the establishment and operation of REDD+ projects and that determine benefit distribution among project proponents and government agencies.[73]

A key policy reform required for REDD+ incentives in most countries is the creation of property rights over carbon and laws to clarify tenure over forested land.[74] In many developing countries competing claims and conflicts between landholders, governments, and private interests often arise over access to forest resources. In Mexico, Costa Rica, and Brazil, establishing clear rights over forest carbon resources and land tenure is considered critical to development of REDD+ programs in carbon trading and for the equitable and workable distribution of benefits.[75] Despite the emphasis on tenure reform, progress has been slow in these and other REDD+ counties in preparing legal frameworks to resolve underlying rights and access to land.[76]

MRV and Engagement

With the implementation of REDD+, the different rationalities that underpin the market and regulatory modes of governance are actively shaped and propagated through governmental technologies. Several of these technologies are performance-based, including MRV systems and project accreditation standards. MRV systems aim to track the land-use activities that cause emissions from deforestation and forest degradation, and for reporting on the effects of REDD+ interventions and programs.[77] At present, many developing countries have relatively insufficient technical capacities and human resources capable of monitoring change in complex forested ecosystems.[78] Consequently, countries are re-

70. Hajek et al. 2011, 11.
71. Bayon et al. 2007.
72. Merger et al. 2011.
73. Government of Indonesia 2012.
74. Doherty and Schroeder 2011.
75. Corbera et al 2011.
76. Larson et al. 2012, 160.
77. Gupta et al. 2012.
78. Herold and Skutsch 2011, 7.

ceiving significant financial and technical support to develop the capacity to undertake MRV, and to establish dedicated facilities to conduct the reporting and manage the data and information. As REDD+ countries progressively implement their national MRV systems, large areas of forested land will increasingly fall under the technical surveillance and regulation of national administrations and the UNFCCC. This extension of techno-green governmentality[79] directly links activities on the ground with national REDD+ programs and international rules, guidelines, and funding sources. If implemented comprehensively, MRV systems will function as a multi-layered system of technical surveillance that expands the state capacity to monitor and potentially control forest margins and the activities of multiple agents.

The governance of REDD+ is also shaped by deliberative rationalities that seek to engage and bind numerous and often competing stakeholders into program development and implementation. Most REDD+ countries face significant challenges with regard to democratic processes and engaging with constituencies in policy reforms and development projects. Indeed, many local forest users, indigenous people, and private business interests have been hostile to interventions that restrict access to forest resources and reduce income and employment opportunities.[80] As REDD+ requires ongoing and long term management of vast forest ecosystems, the involvement of diverse interests through formal and semi-formal participation frameworks provides a set of mechanisms that could improve forest governance and secure rights for marginalized people.[81] In this context, the effectiveness and equity of REDD+ national and sub-national activities is built upon the assumption that participation by multiple stakeholders is essential for program success.

Participation is also driven by international agreements and demands from donor countries and NGOs. The recently negotiated agreements at COP-16 in Cancun in 2010 require national governments and their partner organizations to conduct formal consultation processes with all relevant stakeholders, including the free prior and informed consent (FPIC) of indigenous peoples. In Indonesia, Vietnam, and Brazil, public agencies and supporting partners such as the UNREDD Programme conducted stakeholder consultation processes as part of the national strategy development and in demonstration programs at provincial and district levels. In line with international safeguard requirements, the Indonesian government has also developed a framework for FPIC as a condition of engagement with stakeholders at the sub-national level.[82] Project developers also integrate processes for consultation and participation, providing an opportunity to deliver information on REDD+ interventions and to conduct training in forest management and monitoring.[83] In the Berau Forest Carbon

79. Bäckstrand and Lövbrand 2006.
80. See Bulkeley and Newell 2010.
81. Lawler et al. 2010; Chhatre et al. 2012.
82. Government of Indonesia 2012.
83. Jagger et al. 2012.

Program in Central Kalimantan, Indonesia, the project is built around partnership arrangements that engage authority at different levels, including district governments, village leaders, and community representatives.[84] These technologies of agency attempt to integrate multiple and competing land users as active agents of policy reform and project implementation. They also constitute a mechanism through which deliberative and economic rationalities can be operationalized in multiple contexts and locations.

Conclusions

Analysis suggests that programs aiming to manage carbon in natural and human-dominated ecosystems function through overlapping and at times complementary administrative, market, and deliberative rationalities. The initiatives and programs appear to adopt coherent logics about ways to reduce emissions and achieve outcomes in controlling forest loss and managing soils. A consistent set of governmental technologies and forms of knowledge governs ecosystem carbon. For many countries, these policy approaches are driven by external forces, such as international agreements, and in the case of REDD+ by bilateral and multilateral funded programs.

The adoption of these common policies and processes has significant implications for how land and forests will be managed in the future. The push for adoption of market-based instruments increasingly draws countries into a global system of land-based carbon commodities, as well as constraining how they manage domestic forestry issues and exercise sovereignty over natural resources. REDD+ policy reforms to facilitate this process, particularly rules for benefit distribution and tenure resolution, will yield positive and negative impacts on local communities.

At this stage, however, hurdles to setting up an effective market for REDD+ are considerable, and the potential to deliver on large-scale forest management remains uncertain. In developing countries, the broad integration of carbon mitigation into regulatory and planning instruments and the focus on building technical and institutional capacity at the national and sub-national scale has implications for longer-term forest land use. Strengthening enforcement capabilities and building MRV systems should improve how governments monitor forest resources and land-use development. Countries need to meet international reporting requirements and implement agreed policy reforms to access future funding. Facilitating widespread participation by non-state stakeholders from the national to the local scale may also provide better awareness of reforms and foster more democratic and potentially equitable forest activities. As some demonstration activities have shown, local communities are increasingly part of the enforcement capability of government agencies, but also

84. Ministry of Forestry and the Nature Conservancy 2010.

co-developers and operators of carbon offset projects and sustainable land-use options.

Despite increased participation by non-state actors, public authorities at national and sub-national scale remain dominant, in many cases expanding their authority to govern land, forest and agricultural resources. Herein lies the major challenge for developing governments to effectively reduce emissions when they have comprehensively failed to manage land and forest resources in the past. Considering the central role of the state, increasing accountability and reducing collusion and corruption among government and business elites may provide the only viable short-term option for effective implementation of mitigation programs in these sectors.

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